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1947 *Seventieth Annual Report*

Vol. VI, No. 3

North Carolina Agricultural Experiment Station

April, 1948



ON THE COVER: Soil specialists have long wanted to know how much of its food the plant gets from the soil and how much comes from the fertilizer. The development of radioactive isotopes of the different fertilizer elements makes such a study possible. This young tobacco plant was grown on soil to which radioactive phosphorus had been added. The plant parts were pressed against a photographic negative and exposed for a few days. Light areas show the location of the phosphorus. Note that the younger the tissue the greater the concentration of phosphorus.

Research AND FARMING



1947

Seventieth Annual Report

Agricultural Experiment Station, North Carolina State College of Agriculture and Engineering of the University of North Carolina. Fiscal Period of July 1, 1946 to June 30, 1947. Progress Report For December 1, 1946 to November 30, 1947. The North Carolina State Department of Agriculture Cooperating.*

*Raleigh—North Carolina State College and Central Experiment Station

Plymouth—Tidewater Branch Station

Willard—Lower Coastal Plain Branch Station

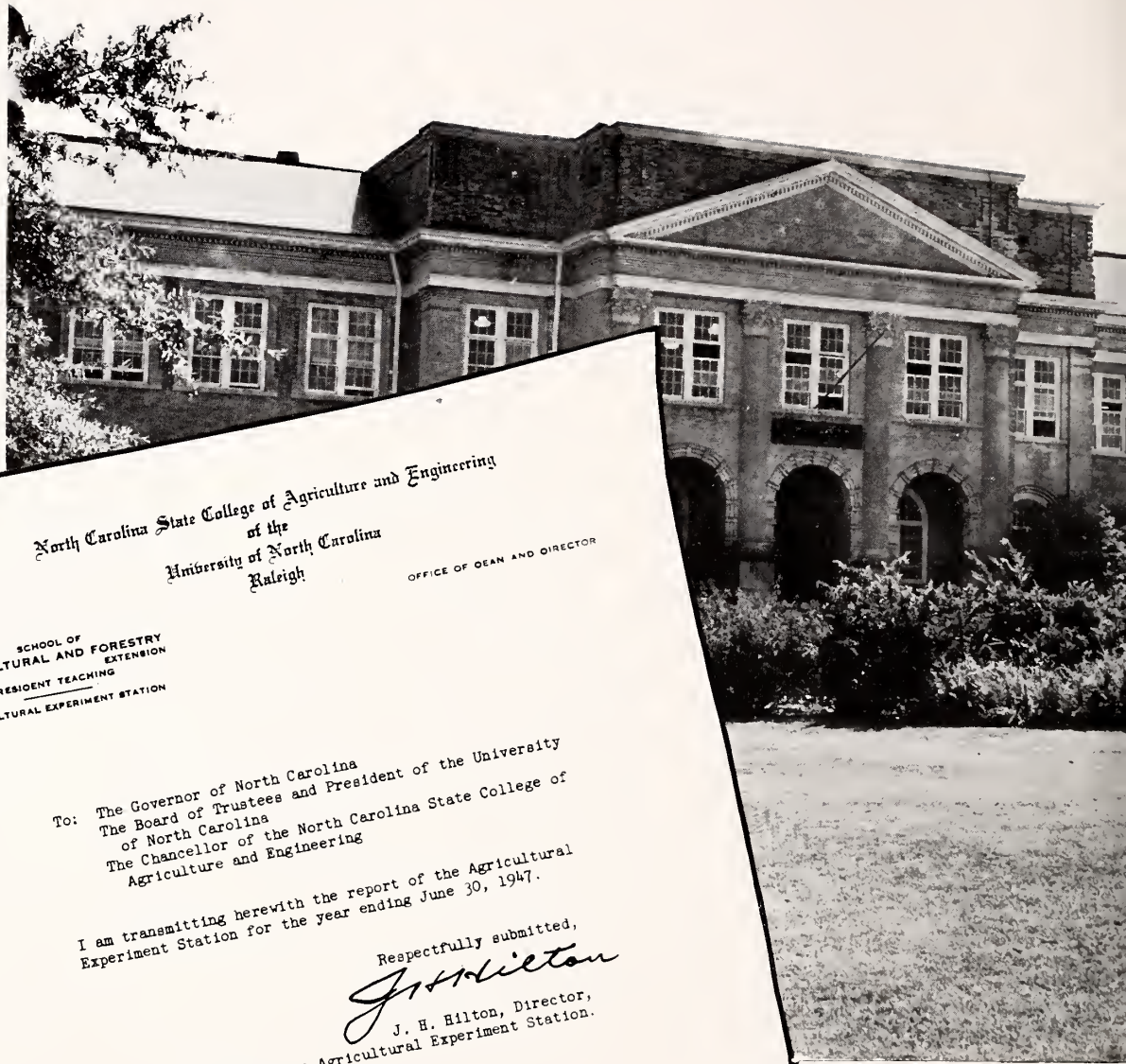
Rocky Mount—Upper Coastal Plain Branch Station

McCullers—McCullers Branch Station

Oxford—Tobacco Branch Station

Laurel Springs—Upper Mountain Branch Station

Waynesville—Mountain Branch Station



North Carolina State College of Agriculture and Engineering
of the
University of North Carolina
Raleigh

OFFICE OF DEAN AND DIRECTOR

SCHOOL OF
AGRICULTURAL AND FORESTRY
RESEARCH EXTENSION
RESIDENT TEACHING
AGRICULTURAL EXPERIMENT STATION

To: The Governor of North Carolina
The Board of Trustees and President of the University
of North Carolina
The Chancellor of the North Carolina State College of
Agriculture and Engineering

I am transmitting herewith the report of the Agricultural
Experiment Station for the year ending June 30, 1947.

Respectfully submitted,

J. H. Hilton

J. H. Hilton, Director,
North Carolina Agricultural Experiment Station.



Patterson Hall, center of agricultural activities at State College, and headquarters of the North Carolina Agricultural Experiment Station.

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* Vol. VI

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April, 1948

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R. W. Cummings **Associate Director**
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Research and Farming is free to all residents of North Carolina. If you wish to receive this publication regularly, address your request to the editor, and your name will be placed on the mailing list.

* Due to a change in the publishing year, there will be no Progress Report No. 4 for Vol. VI. The next issue will be Vol. VII, No. 1 dated July, 1948.

Field Crops



Breeders Score Corn Heredity



PLANT BREEDERS are able to plan their work more effectively if they can find out the relative importance of heredity and environment. H. F. Robinson, R. E. Comstock and Paul H. Harvey conducted an experi-

ment during 1946 and 1947 in an effort to get this information for several lines of corn combined into segregating crosses.

They express their results as "heritability" which is merely the ratio of inherited to total variation. The following heritability values were obtained on eight characters in segregating single crosses:

<i>Character</i>	<i>Heritability Per Cent</i>
Plant height	70.1
Ear height	55.4
Husk length	49.5
Husk score (length and tightness)	30.2
Ears per plant	23.6
Ear length	17.3
Ear diameter	14.1
Yield	20.1

These results indicate that the selection of individuals would be very effective for such characters as plant height and ear height. However, selections to improve ear length or ear diameter would be much more difficult. Only one-fifth of the difference in yield between any two plots of corn in this study was due to heredity. The remainder was due to such environmental variations as soil fertility, cultivation, soil material and insects.

Dixie 17 Excels In Coastal Plain Tests

Dixie 17, the new white hybrid, averaged 110.6 bushels of grain per acre in seven locations across the Coastal Plain. The best open-pollinated variety averaged 92.7 bushels per acre.

In all of the Coastal Plain locations moisture was plentiful throughout most of the season. In contrast, the four Piedmont locations were hit by drought. Under these dry conditions Dixie 17 produced 58.6 bushels per acre, or 42 per cent more than the best open-pollinated variety.

Dixie 17, Tenn. 10 and N. C. T20 have been compared in 13 tests during 1946 and 1947 with the following average yields respectively: 83.4, 77.0, and 70.7 bushels per acre.

Throughout the eastern half of the State N. C. 27 has been praised highly by those growing this yellow hybrid. The good shuck coverage protected the grain during the wet fall weather so that when housed late the grain was still in good condition. During the past three years this hybrid has averaged 65.1 bushels per acre in 21 trials in contrast to Jarvis Golden Prolific at 50.2 bushels per acre. The yellow hybrid, N. C. 26, averaged 66.2 bushels per acre in these same trials. While N. C. 26 has

These are ears N. C. 27, showing the good grain quality of this yellow hybrid.



shown slightly higher yields than N. C. 27, the stronger stalks, sound grain, and weevil resistance of the latter hybrid makes it a better all-purpose corn.

N. C. 26B appears to be an improvement over N. C. 26. It is equal to or better than N. C. 26 in yield, has shorter stalks, less lodging and somewhat less weevil damage.

A similar comparison was made between N. C. 1032 and N. C. 1032B. In the two Piedmont trials N. C. 1032B produced more corn than N. C. 1032. However, in an average of all four trials, N. C. 1032 produced 61.8 as compared to 60.6 for N. C. 1032B.

West Virginia Hybrids Promising

W. Va. B8 and W. Va. 1163 averaged 74.5 and 73.6 bushels per acre in three tests conducted at Laurel Springs by Harvey. The yields compare

favorably with the late hybrids, U. S. 282 and Dixie 44, which averaged 74.2 and 73.2 respectively.

The West Virginia hybrids are early-maturing so that even the early frost of September 28 did not injure them. While no seed is available for either of these hybrids, plans are under way for their production.

In three tests in the lower mountain area, U. S. 282 averaged 62.4 bushels per acre. In the same tests Holcombe Prolific averaged 55.7 bushels and US 282C averaged 67.5 bushels per acre. In addition to better yield, U. S. 282C has more intense yellow color in the grain.

Dixie 44 has performed equally well with an average of 66 bushels per acre. The best white hybrid has been Dixie 17 with an average of 74.6 bushels. However, Dixie 17 is too late maturing for much of the mountain area.

Early Row Fertilization Stimulates Corn Inbreds

Since corn inbreds start growth more slowly than hybrids, early stimulation is extremely valuable in producing seed stock. Early growth is so slow in many inbreds that cultivation and weed control become serious problems.

Experiments testing the effects of early row fertilization were conducted by B. A. Krantz and P. H. Harvey. They noted growth stimulation as early as 19 days after planting. Measurements taken just before tasselling indicated a significant increase in plant height up through 800 pounds per acre row applications. Average yields of four corn inbreds were increased fourfold by increased fertilization and spacing.

The ideal planting rate for corn inbreds was found to be about half again as much as that recommended for prolific corn hybrids. Average per acre yields from heavily fertilized plots of inbreds were: 10,000 plants per acre, 34 bushels; 14,500 plants, 42.9 bushels; and 19,000 plants, 46 bushels. One of the inbreds, NC12, produced 62.6 bushels per acre.

Nitrogen fertilization has boosted corn yields rather consistently in experiments of the past four years. Krantz reports an increase in one 1947 test that tops all previous records at the Station. The yields from plots receiving 0 and 180 pounds of nitrogen were 19.1 and 120.9 bushels, respectively.

These plots are part of an experiment with corn planted on the same land in consecutive years. Each year the ear corn is removed and all residues left on the land. It is interesting to note that the yield difference between the zero and high nitrogen treatment has increased each year.

The rate of nitrogen in the high nitrogen plot was 120 pounds during 1944 and 1945, and it was raised to 180 pounds per acre during 1946 and 1947. The yield difference between the zero and high nitrogen plot for each year was: 1944, 42.8 bushels per acre; 1945, 60.7 bushels; 1946, 85.9 bushels; and 1947, 101.8 bushels.

Rainfall during June, July and August was about 65 per cent of normal in 1944 and about normal in the other three years.

Nitrogen Increases Yields Tenfold

Nitrogen side-dressing was used most efficiently when all or most of it was applied early (the knee-high stage.) These experiments involved 16 plots receiving different rates of nitrogen application on different dates.

Where only 20 pounds of nitrogen side-dressing was applied, time of application made little difference. At all the higher rates, the knee-high treatments yielded significantly higher than the pre-tassel treatments.

When the side-dressing was split into two applications with varying amounts at the knee-high and pre-tasselling stage, the yields were about the same as when the single application was applied at the knee-high stage. Similar results were obtained in five other experiments.

There was no yield response to the application of minor elements in any of the 30 corn experiments conducted in seven lower Coastal Plain counties during 1947. However, slight leaf deficiency symptoms were observed under some soil conditions. Krantz expects deficiencies of minor elements to become more evident as more growers adopt methods leading to higher yields.

BUSHELS OF CORN PER ACRE



The same amount of fertilizer produced almost 30 bushels more per acre when applied at the right times.

Association Produces Hybrid Seed to Plant Fourth of State's Acreage

Over 68,000 bushels of N. C. Certified Hybrid Corn seed were produced by members of the N. C. Crop Improvement Association in 1947, according to R. P. Moore, Director in Charge. At normal planting rates this is enough to plant one-fourth of the State's corn acreage. There are indications

that farmers would plant 50 per cent of their corn land in hybrids if they had the seed. Seed supplies are still far below the demand.

Nine hybrids were grown under certification regulations. These hybrids together with their supply are:

Yellow Hybrids

N. C. T11	1,400 bushels
N. C. T23	1,600 bushels
N. C. 26	20,000 bushels
N. C. 27	18,000 bushels
N. C. 1032	6,100 bushels
U. S. 282	1,800 bushels

White Hybrids

N. C. T20	6,200 bushels
Tenn. 10	6,400 bushels
Dixie 17	7,100 bushels

Although the yields per acre of foundation seed stock were disappointing in 1947, the total production was greater than ever before. They will allow the seed growers to increase the production of certified hybrid corn seed in 1948. Yield of single cross seed production varied from 55 pounds per acre to 870 pounds per acre for the different single crosses. The average was 400 pounds for all combinations.

Soil Treatments Prove Effective on Wireworms



The "corn" wireworm (left) is the larval or worm stage of the adult beetle (right) commonly called the click beetle or snap jack.

Soil treatment with small quantities of benzene hexachloride may solve the problem of controlling rootworms and wireworms in corn seedlings. Tests conducted by Walter M. Kulash showed that as small a quantity as 0.2 pound of gamma benzene hexachloride may be enough to control these pests.

Probably the best method of applying this material is to dust it on the soil surface before planting time. It may then be plowed under or worked into the soil by harrowing. Applied in this manner

as late as the day of planting, benzene hexachloride did not injure seedling corn so as to be noticed. Nor did it have any effect on germination. This may not be true for other crops, however.

Unfortunately, the long-time effects of benzene hexachloride on the soil, its residual powers and the off-flavor it may produce in some root crops is not well known. Until more information is available on these points, the chemical cannot be generally recommended for the control of soil pests.

In 1947 experiments for the control of earworms in sweet corn, Kulash obtained the best results with 0.25 per cent DDT in mineral oil. This mixture was applied directly to the silk channel with a hand oil can. Only one application was necessary, but this had to be made just as the silks began to wilt. Earlier applications may interfere with pollination.

Some other materials tested gave better than 50 per cent clean (worm-free) ears. These included spray applications of 0.25 per cent wettable DDT, 0.25 per cent DDD (an analog of DDT), 0.25 per cent *Ryania* (a plant product insecticide), and a dust of 40 per cent *Ryania* (*Ryania ED-41*).

The following treatments gave less than 50 per cent worm-free ears: dusts—5 per cent DDT, 5 per cent bis (methoxyphenyl) trichloroethane, (methoxy analog of DDT), *Ryania 40-D* (40 per cent wood, 5 per cent benzene hexachloride, 5 per cent chlordan, 5 per cent chlorinated camphene, and a spray of 0.25 per cent parathion. DDT in oil and the benzene hexachloride treatments flavored the corn.

Tests for the control of stored grain pests showed that 5 per cent DDT dust at the rate of one ounce per bushel prevented rice weevil infestations up to at least one year after treatment. Lower concentrations of DDT, especially when applied by the Slurry method, provided excellent protection against the rice weevil. Seed treated with DDT should not be used for food.

Develop Control For Corn Leaf Spot Diseases

Corn leaf spot diseases which have been especially widespread in the coastal plain during wet seasons such as the past three may soon be brought under control. After experimenting since 1945 with the heritability of such diseases, P. H. Harvey and his associates expect to develop resistant strains of corn within two years.

During the 1947 growing season, Harvey artificially induced an epidemic of *Helminthosporium maydis*. This test showed inbreds NC18, Tx61M, L569, Tenn. J526-2 and others to be resistant. Inbreds NC52, NC16, NCJ315 and NC65 were highly susceptible to the secondary infection which followed the original inoculation. All inbred strains and hybrids were susceptible when artificially inoculated.

The remaining 120 inbreds varied in their degree of susceptibility with most of them being intermediate between the two groups mentioned. By isolating the resistant lines, Harvey expects to produce hybrids better adapted to the coastal plain region.

Artificial inoculation with *H. carbonum* gave the breeder an excellent chance to select resistant plants in the advanced generations of three crosses: NC33 x NC37, NC37 x NC54, and NC37 x L10. NC37 proved to be completely susceptible and has given total losses where it is being planted to increase the foundation seed stocks for the white hybrid Dixie 17.

Fortunately, Harvey finds that his work with these three cross populations agrees with similar work in Indiana, showing the inheritance of susceptibility to be on a simple basis.



This plot of NC 52 shows leaves that are severely spotted with *H. maydis*.

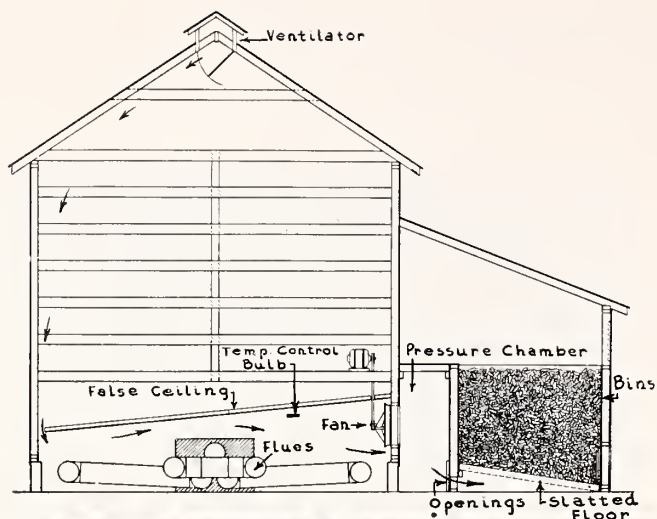
Tobacco Barns Make Good Emergency Corn Dryers

A method of safely using a stoker-fired, flue tobacco barn to dry ear corn seed has been worked out by J. W. Weaver, Jr., and S. H. Usry.

A false ceiling made of asbestos cement board or sheet metal is installed in sections so that it can be removed easily for curing tobacco. It may be hung from or laid on the bottom tier poles. Corn to be dried is loaded into bins under a shed beside the barn. A fan draws air down through a four-inch opening between the false ceiling and the side of the barn opposite the shed.

The air is heated as it is drawn across the barn, under the false ceiling and over the flues. The fan then forces the heated air into a pressure chamber. The flow of air from the pressure chamber into the drying bins is controlled by opening or closing gates near the floor of the chamber. A slatted floor supports the corn and gives the space needed beneath for good drying.

The temperature control bulb of the stoker is placed near the point where the heated air enters the fan. The stoker thus can be set to keep an air



The common tobacco barn can be easily converted into an emergency grain or corn-drying unit.

Small dryers for corn and other crops came on the market in 1947 at a cost of 40 to 60 cents per bushel of capacity.

temperature of 105 degrees F. in the pressure chamber. A 40-pound stoker in an 18-foot tobacco barn has a capacity of about 800 bushels of dried shelled corn in three week's drying time.

Two drying bins are built, each seven feet wide, nine feet long and six feet deep. One bin is unloaded and reloaded while the other is drying. Early-harvested seed corn is too wet to shell and must be dried on the cob. A plan, showing how to fix a tobacco barn for drying corn, can be had by writing the Agricultural Engineering Department at State College, Raleigh.

Small Seed Corn Dryers Appear On Market

Machinery for drying large quantities of hybrid corn seed has been on the market for a number of years. Smaller dryers of reasonable cost appeared for the first time in 1947. Weaver and Usry find that the new manufactured dryers have capacities ranging from 800 to 2,500 bushels per drying season of three weeks.

Cost of the new units averages from 41 to 58 cents per bushel capacity and compares favorably with that of the larger types. Large dryers with capacities from 3,000 to 30,000 bushels cost from 20 to 70 cents per bushel capacity. When the production of hybrid corn seed was started on North Carolina farms in 1945, dryers smaller than 3,000 bushels were not available. Several 1,000-bushel dryers were assembled at that time, costing about 85 cents per bushel of capacity.

Only three of the 274 seed growers in North Carolina produced 3,000 bushels or more in 1947. These new, smaller dryers will fill the need of many growers who might otherwise have to install a larger unit than needed or pay the extra price of an assembled dryer.



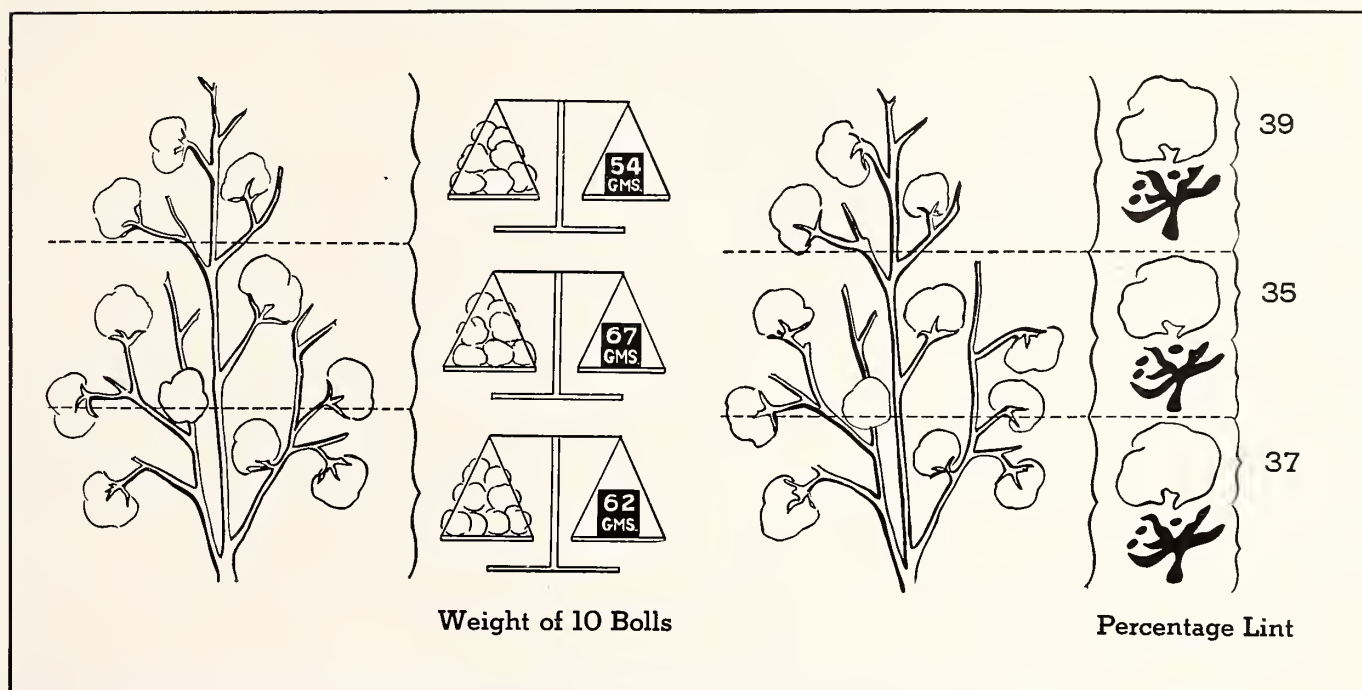
Boll Location Affects Lint Quality

TO DETERMINE SOME of the differences between cotton that opens early and that which opens late, a study was conducted during 1946 and 1947 by W. L. Nelson, C. D. Welch, and W. S. Moore.

Bolls were sampled separately from the top one-third, the middle one-third and the lower one-third of the plant. The

characteristics of the lint and seed from each were determined.

The lint from bolls of the top portion was found to be shorter in staple, finer and stronger than lint from the lower and middle portions. The top bolls were smaller, but the lint percentage greater. Seed from the top bolls contained a lower percentage of oil and nitrogen. The results showed some of the differences that may be expected between the first and second pickings of cotton.



Bolls from the top of the cotton plant are smaller but have a greater lint percentage.

Farmers Lose \$10 to \$50 Per Bale On Weather Damaged Cotton

Samples of lint picked on November 21 were from one to four grades below those picked on October 1, in weather-damage tests conducted at the Upper Coastal Plain Station by P. H. Kime and Thomas Kerr.

Twelve varieties, representing the leading types in the cotton belt, were included in the tests. The fields were defoliated about September 20, and

the bolls were nearly all open by October 1. Samples of each variety were picked from the middle part of the plants on October 1. The remainder of the crop was left in the field until November 21 when other samples were picked.

The ginned samples were graded and stapled by government classers. Samples of lint were also sent to the fiber laboratory for routine tests. In

addition to being of lower grade, the November 21 samples had staple lengths from 1/32 to 1/8 inch shorter. Returns from the fiber laboratory showed that strength as well as length decreases with weathering.

Kime and Kerr estimate that farmers lose from \$10 to \$50 per bale due to weathering in the field. This does not include damage to the seed or losses due to cotton falling out on the ground. Their tests indicated that certain varieties withstand weathering better than others.

In other experiments the two workers tested 45 first generation hybrids by making all possible combinations of 10 varieties and strains. These ten represented the leading types of cotton grown throughout the cotton belt.

Twenty-seven of the 45 crosses produced 10 to 25 per cent higher yields than either of their respective parents. Yield increases were due mainly to the production of a larger number of bolls per plant. However, the number of seed per boll and lint per seed influenced yield to some extent.

Seed Treatment Eliminates Need For Thinning Cotton

By finding the potential germination of his cotton seed and treating the seed before planting, the grower can now select a planting rate which will make thinning unnecessary. S. G. Lehman, in cooperation with the North Carolina Department of Agriculture, secured this information in tests conducted last year at the Upper Coastal Plain Branch Station near Rocky Mount. The test plots were located on Norfolk fine sandy loam.

In a preliminary greenhouse germination test, 68 per cent of the untreated seed emerged, but only 17 per cent were disease free. In the same test, 74 per cent of seed treated with Dow 9B emerged, and all emerged plants were disease free.

In field tests, the seeds were treated with Dow 9B, counted, and dropped by hand in rows with the hills spaced 12 inches apart. Three planting rates—four, six and eight seeds per hill—were used in two-row plots. One row of each plot was thinned to three plants per hill. No thinning was done on the other row.

At picking time there was no difference in the average number of hills on unthinned and thinned rows seeded at the same rate. On rows where four, six and eight seeds per hill had been planted, an average of 11, 6 and 2 per cent of the hills were missing. The missing hills were well-distributed, and resulted in very little, if any, reduction in yield.

At these same planting rates, the average numbers of plants per hill were 2.4, 3.3 and 3.8 on the unthinned rows, and 2.3, 2.6 and 2.8 on the thinned rows. On rows planted at the lowest rate the average number of plants per hill was ample for highest yields. The vacant hills were scattered so that yield losses expected from them were made up by the increased yield of adjacent plants.

Thinning the plants did not increase yields

above that of unthinned rows, nor was there a significant difference in yield from the different planting rates used. Under conditions of this test planting, four to six seeds per hill was enough for highest yields. Thinning was not necessary.

Winter Treatment Recommended

In another experiment, Lehman found that it is possible to treat cotton seed during the winter months, and thus avoid this extra work at planting time.

Dow 9B and Ceresan M were applied to seed of the Mexican variety 53 days and 13 days before planting. Each material was used on some lots at the recommended rates—an ounce and a half per bushel of seed. On additional lots Dow 9B was used at twice the recommended rate, or 3 ounces per bushel. After treatment the seed was stored in a dry, unheated seed house.

Each lot of treated seed was planted alongside a plot of untreated seed, the latter to be used as a check. All planting was done on April 23 in very fine sandy loam of rather poor drainage. Counts were made of the number of seedlings which came up and lived to thinning time. Seed treated by either of the two materials produced considerably more seedlings than did untreated seed. Both long and short storage gave similar increases.

Another experiment proved that effects of the treatment last for at least a year. In this test cotton seed was treated with Ceresan M and Dow 9B in March 1946 and stored in bags in a dry, open-front building until planting time a year later. When planted in April 1947 this treatment gave a larger number of plants than did year-old seed treated eleven days before planting.

Lehman concludes that cotton seed of proper moisture content for storage may be treated several months before planting without harm to the seed. However, treated seed must be kept in a dry storage house.

Combination Dust Controls Boll Weevil and Boll Worm

Benzene hexachloride, chlorinated camphene and chlordane, three of the most recent and most promising insecticides for the control of cotton insects, were tested in small field plots by Walter M. Kulash. In addition, a combination dust of benzene hexachloride and DDT was used.

All three were used in replicated field plots for the control of the boll weevil and the cotton bollworm. In tests for the control of bollworm, 20 per cent chlorinated camphene gave the best results, based on infestation counts and yield records. Benzene hexachloride dust, 5 per cent, did not give satisfactory control of the bollworm. However, the combination dust of 3 per cent gamma benzene hexachloride and 5 per cent DDT gave good control. Cotton treated with 5 per cent chlordane was as heavily infested with bollworms as untreated cotton.

Three of the dusts gave satisfactory control of the boll weevil. They were 5 per cent gamma benzene hexachloride, the combination benzene hexachloride-DDT dust, and 20 per cent chlorinated camphene. Chlordane dust at the 5 per cent concentration did not give adequate control. None of the materials used were effective against the red spider. Trials with one per cent gamma benzene hexachloride demonstrated the effectiveness of this material in controlling aphids and thrips on seedling cotton.

The possibility of checking boll weevil development in the cotton square was not investigated. It was possible, however, to observe that two applications of 5 per cent and 10 per cent chlordane dust upon weevils in late season bolls were not effective. No dead larvae, pupae or adults were noticed in the dusted cotton.

Airplanes are being used widely for cotton insect control.





Ladino-Fescue Pasture Promising

LADINO CLOVER-TALL FESCUE (Kentucky 31) was one of the most productive pasture seeding combinations during 1947 at the Lower Coastal Plain Station, Willard, North Carolina. The studies were conducted by R. L. Lovvorn, D. W. Col-

vard, W. W. Woodhouse, Earl W. Faires, and R. K. Waugh.

The Ladino-fescue combination, seeded in October, 1946, provided grazing for 129 days during 1947 at the rate of one and one-fourth cows per acre. The grazing was not continuous but stretched from March 31 through November 5. Beginning the last of June, this crop was rotationally grazed with kudzu. These two crops together furnished 199 days of grazing at a rate of over one cow per acre.

Early in the spring of 1946 an old, permanent pasture, made up mostly of carpet grass and scattered Dallis grass with lespedeza and white clover, was divided into four equal parts. One section was left in the established carpet grass while the other three were disked and seeded to the following combinations:

- (1) Ladino clover-Dallis grass.
- (2) Ladino clover.
- (3) White clover-Dallis grass-Kobe lespedeza.

All four pastures received equal lime and fertilizer applications. These pastures were grazed some in 1946, but not experimentally. During 1947 these pastures furnished the following amounts of grazing:

Pasture	Days Grazed	Cows Per Acre
1) Carpet grass	199	0.54
2) Ladino-Dallis	206	0.95
3) Ladino	206	0.96
4) White-Dallis- lespedeza	199	10.1

In addition, seven tons of material were cut from Pastures 2, 3, and 4 and made into silage. There was no surplus growth on Pasture 1. Because of the rank growth of white clover in the clover-lespedeza mixture there was no lespedeza left in 1947.

These three mixtures each produced just about twice the grazing that the original pasture furnished. Both 1946 and 1947 were good years for pastures, particularly as regards moisture.



Ladino clover and tall fescue are proving to be an excellent pasture combination at the Lower Coastal Plain Station, Willard.

Ladino Clover, Big Trefoil Prove Superior in Tidewater Plots

Ladino clover and big trefoil proved far superior to five other legumes growing in association with either orchard grass or tall fescue at the Tidewater Experiment Station during 1947. R. L. Lovvorn, W. W. Woodhouse and D. S. Chamberlee were in charge of the tests.

The legumes, planted in the fall of 1946, produced the following yields during the 1947 growing season:

Ladino clover—orchard grass: 5,141 pounds

Big trefoil—orchard grass: 4,573 pounds

Similar yields were obtained when the two legumes were grown with tall fescue. Earlier observations had indicated that big trefoil was superior to Ladino clover. Although this year's yields did not indicate this relationship, this legume still made much more growth than bur, sub, button or crimson clover or black medic.

Both Ladino clover and big trefoil made nearly

Big trefoil (foreground) and Ladino clover (center) have been far superior to five other legumes in these small plot tests at the Tidwater Station, Plymouth.



as much growth as the winter annuals during April and May and, in addition, continued to grow until frost. The relative value of these two legumes has not been determined for eastern North Carolina. Experiments now in progress should provide a more critical test.

Dallis Grass Yields Low Protein Content

Dallis grass, one of the most popular grasses in North Carolina, is not the most nutritious grass available for use in pastures. Recent studies over a three-year period by Lovvorn, Woodhouse and Chamblee have shown that it is lower in protein than orchard grass.

Dallis grass contained 18.25 per cent during July while orchard grass, grown under the same conditions, analyzed 22.06 per cent protein. Samples collected in October showed Dallis grass to contain only 13.75 per cent protein while the value for orchard grass was 23.13. In these experiments all vegetation was harvested in an immature condition to insure a low fiber and high protein content. Even under such conditions the feeding value as measured by protein content was low for Dallis grass.

This does not mean, however, that orchard grass should always be substituted for Dallis grass. Their adaptations are not the same. Dallis grass is especially suited to the moist lands of eastern North Carolina, whereas orchard grass does better in the Piedmont and Mountains. If planted in the Coastal Plain, orchard grass should be confined to well-drained, productive soils.

Lespedeza Responds to Lime and Fertilization

Lespedeza is sometimes said to be an acid-tolerant legume that is able to grow well without fertilizer. In the accompanying figure, data gathered by W. W. Woodhouse and R. L. Lovvorn, show how some farmers may have gotten this mistaken idea. The results of these experiments confirm the common experience that it pays to lime and fertilize lespedeza.

In this experiment lespedeza showed no response to limestone the first season, as compared with a 200 per cent increase for liming alfalfa. Yet by the third season, liming was becoming almost as important for the growth of lespedeza as it was for "lime-loving" alfalfa.

Lespedeza behaved in much the same way in its response to phosphate. Phosphate was essential for the satisfactory growth of alfalfa from the

beginning. It was of no importance to lespedeza the first year but became increasingly effective in the second and third seasons.

Apparently lespedeza is able to satisfy its needs on this and many other soils the first season or two without the application of lime or fertilizer. Observations of this fact have led to the belief that liming and fertilization for this crop are unnecessary. However, as indicated by this experiment, if the growth of lespedeza is continued, soil treatment may become just as necessary as it is for a less tolerant plant like alfalfa.

New Foreign Lespedezas Tested

In 1946 approximately sixty selections and foreign introductions of annual lespedezas were obtained from the Bureau of Plant Industry. In field tests since then, Clarence H. Hanson has found inherent differences in yield, growth habits,

time of maturity and resistance to powdery mildew.

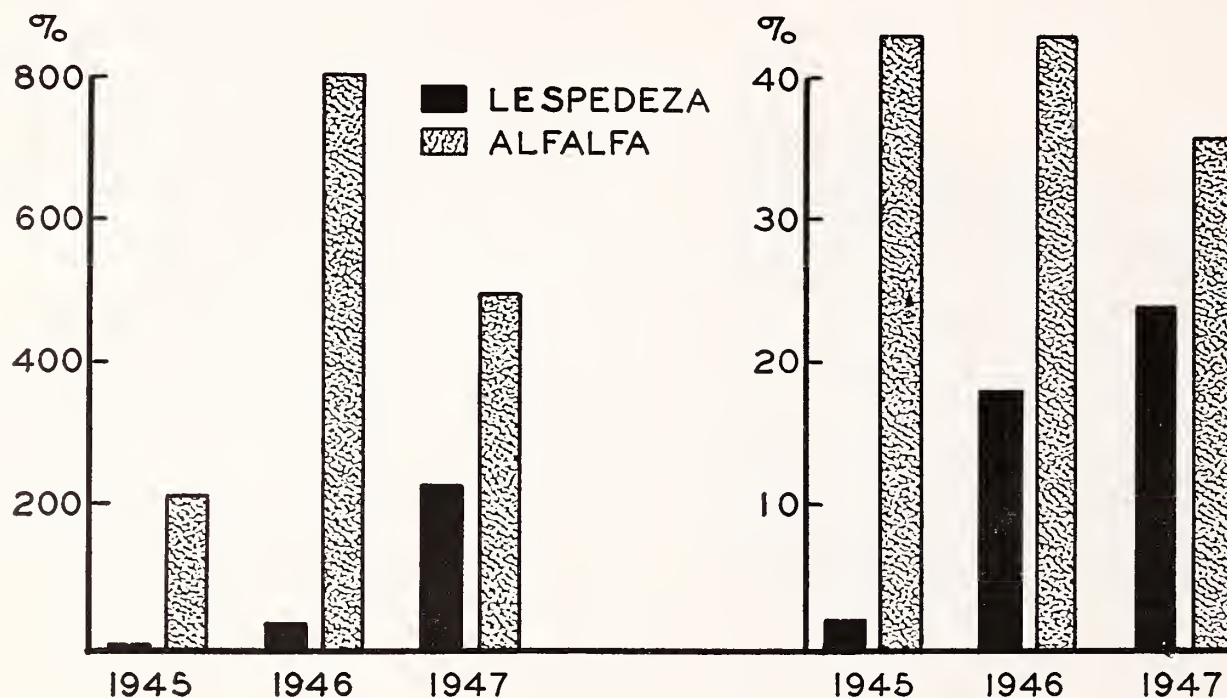
Several of the new strains tested have been more productive than the lespedza varieties now in use. Two year's data have been obtained, but

the varieties must be further tested in other sections of the State to determine their adaptability. Commercial Korean and a late maturing Korean brought in from the Orient are shown in the accompanying picture.

Lespedeza is sometimes called an acid-tolerant legume. But these tests (left) showed that after the first year, lime becomes almost as important to lespedeza as it is to alfalfa. Lespedeza showed a similar response to phosphate (right).

RESPONSE TO LIMESTONE

RESPONSE TO PHOSPHATE



Alfalfa Out-Yields Other Legumes as Hay Crop

Even though alfalfa is a native of a dry climate, it has consistently produced more tons of high quality hay per acre in North Carolina tests than any other legume.

To further improve alfalfa production and quality, Clarence H. Hanson is attempting to develop varieties that are especially adapted to the humid conditions of the east. Alfalfa selections from Kansas, Nebraska and other states cooperating in the National Alfalfa Improvement Conference are being tested for yield, disease and insect resistance.

Lines showing less injury from aphids are shown in the accompanying picture. This is important in the development of a superior variety. This tiny insect has been known to completely destroy alfalfa stands.

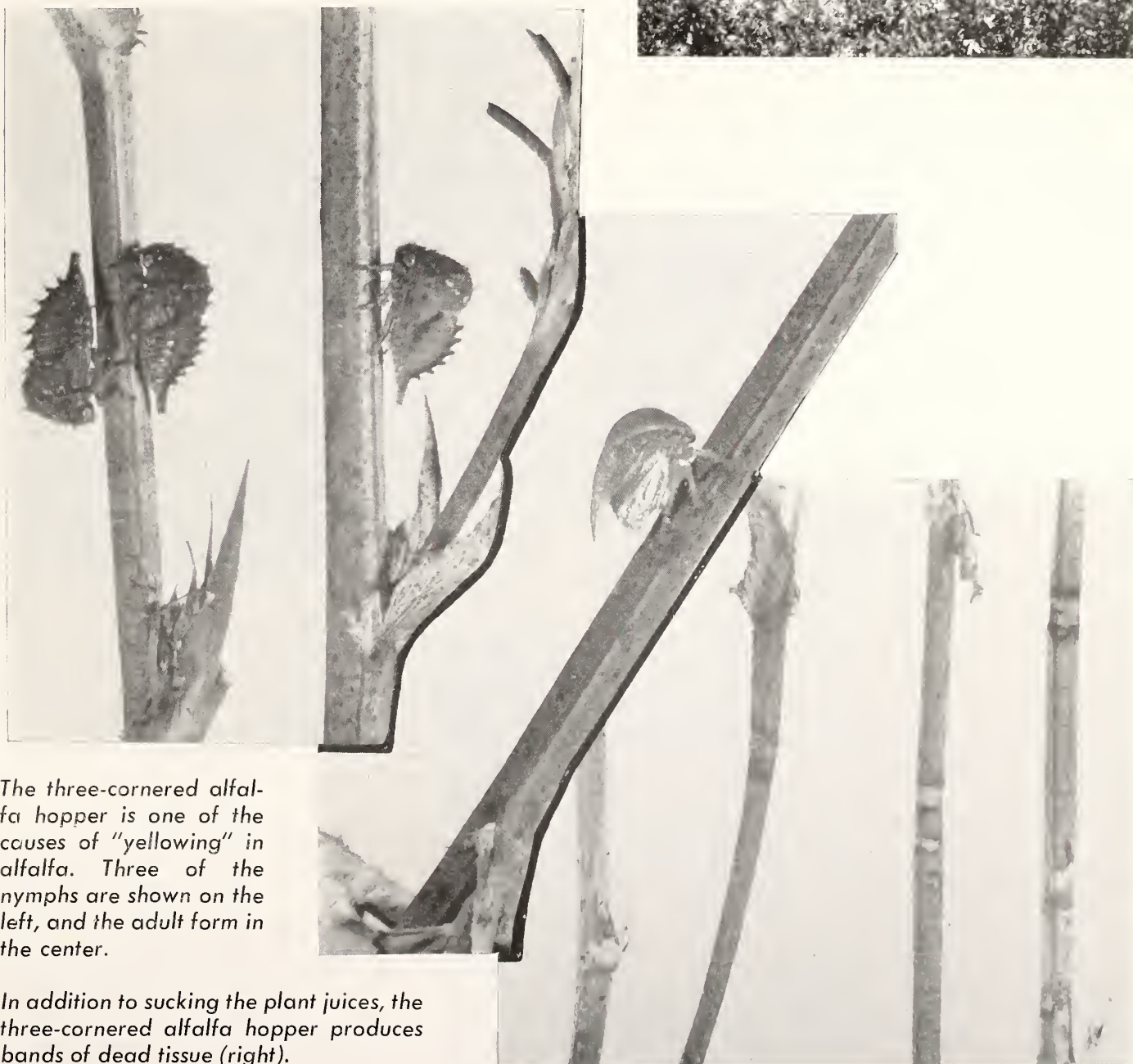
Seed Less Grass With Alfalfa

The problem of whether to seed grass with alfalfa may depend on the amount of grass seed used, according to tests by R. L. Lovvorn and W. W. Woodhouse.

In 1947 experimental seedings of 20 pounds of alfalfa and either 5 or 10 pounds of orchard grass yielded about four tons of hay per acre. When the rate of orchard grass was increased to 15 pounds with 20 pounds of alfalfa, the yields were reduced by one-half ton per acre.

A grass-alfalfa mixture is easier to cure and makes better grazing than alfalfa alone. However, these preliminary results indicate that one must be cautious as to the rate of seeding grass. Too much may actually cut down the yield of hay. In this experiment 15 pounds was too much.

The unthrifty, chlorotic plants in plots 0 and 1 are alfalfa strains susceptible to aphid damage. The Number 2 plot, which shows no ill effects of the insect infestation, is a resistant strain.



The three-cornered alfalfa hopper is one of the causes of "yellowing" in alfalfa. Three of the nymphs are shown on the left, and the adult form in the center.

In addition to sucking the plant juices, the three-cornered alfalfa hopper produces bands of dead tissue (right).

Alfalfa Remains Productive in Coastal Plain

Tests conducted by Lovvorn and Woodhouse since 1942 have proved that productive stands of alfalfa can be maintained on the Coastal Plain.

Seventeen tons of alfalfa per acre has been harvested from an experimental plot since it was established in September 1942. The plot is located in a typical tobacco section on a Norfolk fine sandy loam soil in Johnston County. The average annual yield has been approximately three and one-half tons per acre during this period.

The success of the stand and yield in this particular experiment has been due to: (1) the well-drained soil; (2) adequate sources of lime, phosphate and potash; and (3) proper management with respect to time of harvesting.

Proper Liming Improves Alfalfa Yields

It is generally recognized that alfalfa cannot be grown successfully on most North Carolina soils without liming. Woodhouse and Lovvorn report results of experiments in Wake County which indicate that improper liming may be almost as unsatisfactory as no lime at all.

Method of Applying Limestone

	<i>Yield</i>
Broadcast on the surface	3,362 pounds
Broadcast on the plow sole	4,407 pounds
Mixed with the plow layer	5,416 pounds

Commercial Nitrogen Adds Little to Clover Pasture Yields

Applications of commercial nitrogen have not greatly increased the yields of dry matter or crude protein on a grass-clover pasture in the lower Piedmont.

Results of these 1945-47 trials conducted by W. W. Woodhouse and R. L. Lovvorn are as follows:

	<i>Yield Per Acre in Pounds</i>	
	Forage	Protein
No nitrogen	4,492	1,021
100 pounds nitrogen	4,607	1,036
200 pounds nitrogen	5,114	1,156

These data illustrate that sods containing good clover stands will not respond well to nitrogen. An excellent stand of clover was obtained and maintained throughout the three years of the experiment, accounting for the poor response to nitrogen.

A grass-legume mixture gives the most economical summer grazing in North Carolina. Emphasis should therefore be placed on growing the legume in the sod. Liberal applications of limestone, phosphate and potash will usually insure a good legume growth.

How Often Should Lime Be Applied?

One ton of ground limestone, applied on a permanent pasture sod in 1938, was still effective in 1947, ten growing seasons later.

These data emphasize the importance of mixing the lime with the soil before seeding alfalfa. They indicate that it is poor business to seed alfalfa on inadequately limed soils with the hope of correcting the trouble by top-dressing with limestone later. In other words, if you can't get the lime spread in time to work it in before seeding alfalfa, don't seed.

Three-Cornered Hopper Causes Yellowing

Tests conducted by Clarence H. Hanson during 1947 gave definite proof that the three-cornered alfalfa hopper is one of the causes of the "yellowing" of alfalfa.

In addition to sucking the plant juices, the insect produces bands of dead tissue. The first outward sign of damage is a yellowing of the infected stem above the girdled area. Normal growth is prevented, and under heavy infestations, the whole plant may be killed.

This insect appeared to thrive equally well on all of the alfalfa strains observed. Similar "yellowing" symptoms may appear as a result of mineral deficiencies, disease and certain insects. Methods for controlling the three-cornered alfalfa hopper are now being sought.

In this experiment, located in Haywood County, Woodhouse and Lovvorn found that the one-ton application continued to be more productive than the one-half ton rate and equal to the two-ton rate. The question of how long an application of lime will last is still unanswered. It will vary with such factors as soil, climate, management, and species. A high-producing Ladino clover pasture will probably need reliming oftener than every ten years.

From this example, however, it may be seen that proper liming for permanent pastures is a job that need not be repeated often. It is a profitable and relatively permanent form of improvement, but it should be repeated as often as soil tests indicate the need. It is still lacking on a high proportion of North Carolina's pasture acreage.

Some Legumes Grow Better With Boron

Two of the reasons why some legumes need boron may be seen in analyses made during the 1947 season by Lovvorn and Woodhouse.

White clover and orchard grass, growing on the same plots, were analyzed at three different dates. The white clover was found to contain an average of three times as much boron as did orchard grass. The boron content of both species was relatively constant for the different dates.



Early Life Of Peanuts Studied

AN UNDERSTANDING of the details of cell growth is of great value in the plant breeding, entomology, soil fertility, and plant disease phases of peanut production. John A. Yarbrough recently completed such a detailed study of the early life

history of the peanut.

Peanut addicts are familiar with the thin seed coat which covers the mature seed. The bulk of the seed consists of two cotyledons (seed leaves) filled with the stored foods (oil and proteins) which make the nuts valuable commercially and tasty to man and animal. Between the cotyledons lie the embryo or dormant young plant. The em-

bryo is straight with the root end toward the point of the seed and the shoot pointing in the opposite direction (Figure 1).

As the seed sprouts, the robust tap root is the first organ of the new plant to appear (Figure 2). The tap root pushes two or three inches straight down into the soil before any branch roots are produced (Figure 3). Numerous side branches soon appear, however. Usually these lie horizontally as shown in Figure 4.

The epidermis (surface layer) of most plant roots produces root hairs which absorb water and minerals for the plants. Peanut roots, however, do not have an intact epidermis. The surface cells of the peanut root, even when very young, are collapsing and sloughing off as seen in a highly mag-



Figure 1. One cotyledon has been removed to show the dormant peanut embryo (left, above).



Figure 2. (center, above) Emergence of the tap root.



Figure 3. (right, above) Seedling after three days. Note the prominent collar where the root joins the hypocotyl.



Figure 4. (left, below) Seedling on the 12th day after planting.



Figure 5. (right, below) Peanuts three weeks old. These plants are expanded embryos; except for branch roots, all these organs are present in the dry seed.

nified cross section of a young root in Figure 6.

This means that peanut roots do not produce root hairs of the ordinary type. Yet the plants thrive in moderately moist soil. Peculiar tufts of hairs are formed at the bases of most of the branch roots. Whether these unusual hairs, often branched are useful in obtaining water and minerals for the plant has not been determined. The older root becomes woody and begins to slough off its outer layers (Figure 7). It becomes hollow at maturity.

The hypocotyl of the peanut seedling is the stem-like portion found between the root and the cotyledons. (See Figure 3). The lower limit of the hypocotyl is marked by a distinct swelling (Figure 3) called the collar. As shown in a highly magnified cross section in Figure 8, the hypocotyl develops into a very fleshy structure. Ten days after germination its surface becomes wrinkled and it finally sloughs off all its surface layers as does the root. Thus only a tough, hollow cylinder remains to form the stem base of the mature plant (Figure 9).

The cotyledons are plump and packed with food as the seed begins to sprout. The dark appearance of the individual cells in Figure 10 is caused by

the quantities of food material present. Growth of the hypocotyl may bring the cotyledons to the surface, where they turn green if exposed to light. The growing shoot exhausts the stored food supply rapidly so that they begin to shrivel about ten days after planting and fall from the plant after twenty days. Note the emptiness of the surviving cells in Figure 11.

In the dry seed there are three well developed shoot buds in the embryo with seven to nine leaves already formed within them. These buds begin to grow about five days after planting. The leaves unfold quickly and are busily engaged in producing food for the young plant before the second week has passed. The leaves and stems of the four plants shown in Figure 5 were all fully formed in the buds of the embryo (Figure 1). These organs have merely increased in size and unfolded.

When peanuts have adequate water and are kept free from insect pests, growth proceeds at a steadily increasing rate during the seedling stage.

Some of the researches for the production of more and better peanuts are being built against this background of the knowledge of seedling structure.

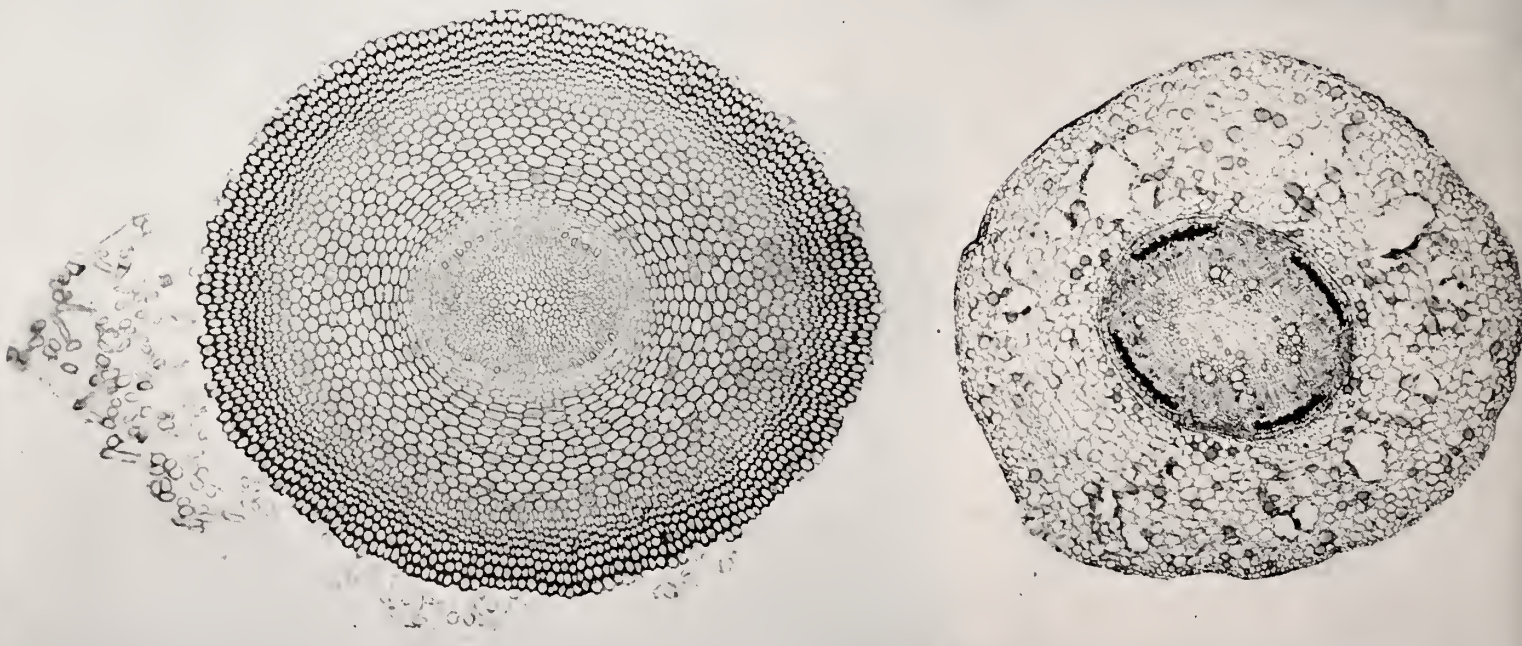




Figure 8: (Left) Cross section of a fleshy hypocotyl on the fifth day of growth.

Figure 9: (Lower Left) Cross section of an older hypocotyl showing the breakdown of the outer layers and the abundance of conducting vessels.

Figure 10: (Below) Cotyledon of an early seedling, containing abundant food.

Figure 11. (Lower Right) Condition of a cotyledon 24 days after planting. The stored food supply is almost exhausted.

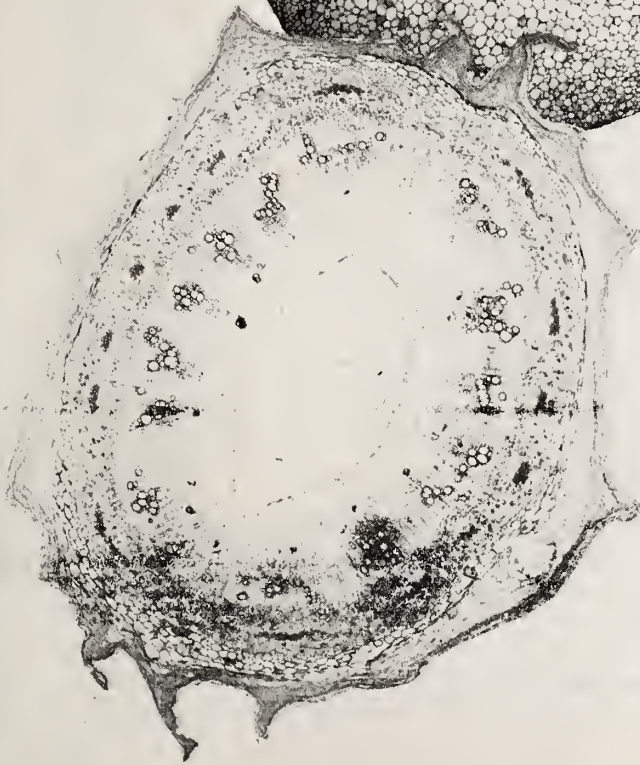
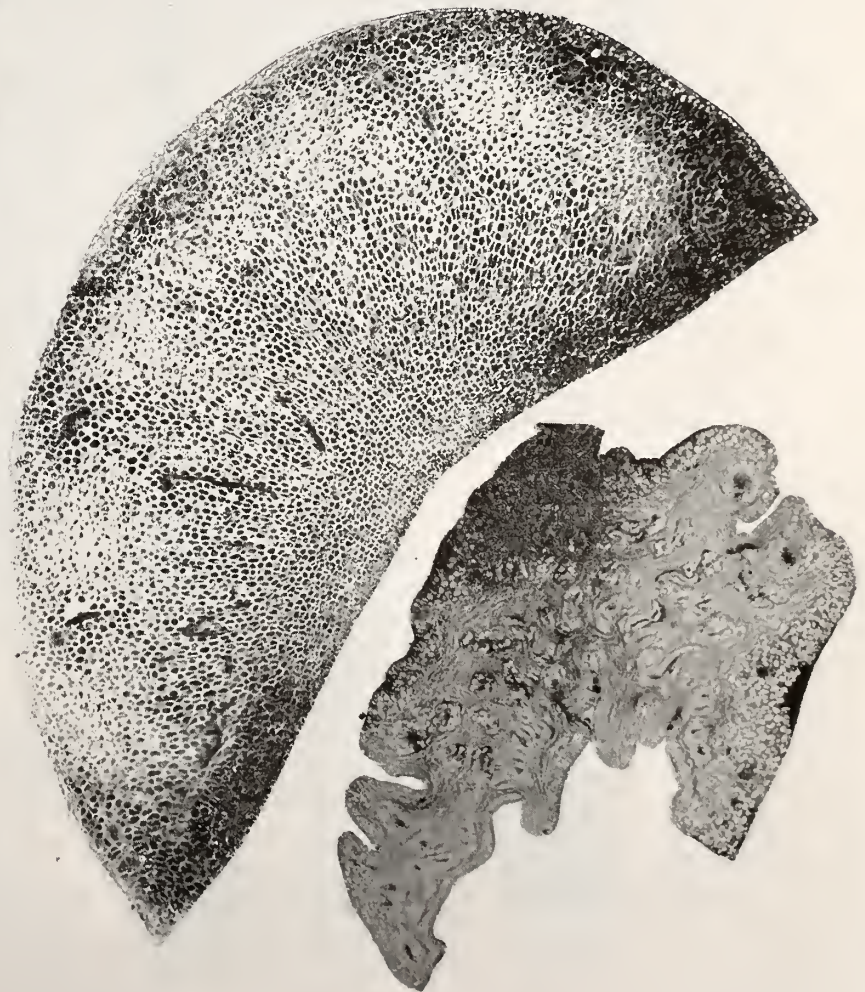


Figure 6: (Extreme Left) Microscopic view of a cross section of the young peanut root, showing various tissues and the early loss of the epidermis.

Figure 7: (Left) Cross section of older root in which outer layers are collapsing before sloughing off.



New Peanut Varieties Yield Up To 3,771 Pounds Per Acre

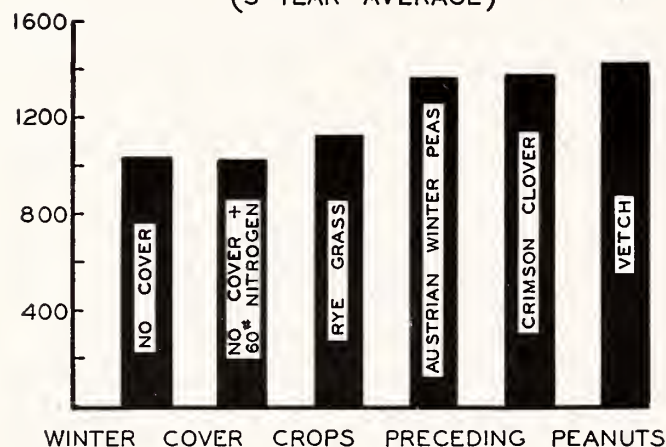
In the breeding material tried out during 1947, W. C. Gregory found peanut plants yielding from 930 to 3,771 pounds per acre. These plants were among the 7,000 grandchildren and 12,000 great grandchildren of peanut crosses tested this year. It was the first indication of progress in the task of producing superior lines of peanuts.

To provide a basis for calculating the individual breeding value of the plants, 28 classes of information were recorded. Gregory aims to combine the high yielding ability of certain plants with the desirable qualities of other plants to form new or better strains adapted to this area.

Legume Cover Crops Increase Peanut Yields 40 Per Cent

YIELD OF PEANUTS IN POUNDS PER ACRE

(3 YEAR AVERAGE)



Legume cover crops increased the yield of peanuts about 40 per cent in a cotton-peanut rotation in Edgecombe County. N. C. Brady, W. L. Nelson, and J. F. Reed report that this increase was not due to the nitrogen supplied by these crops, since 60 pounds of nitrogen added to the "no cover" plots did not increase the yield.

Turning under large amounts of winter cover crops prevented soil packing and left the soil in better physical condition. Measurements showed that the soil in the vetch plots was 45 per cent more easily penetrated than in the "no cover" plots.

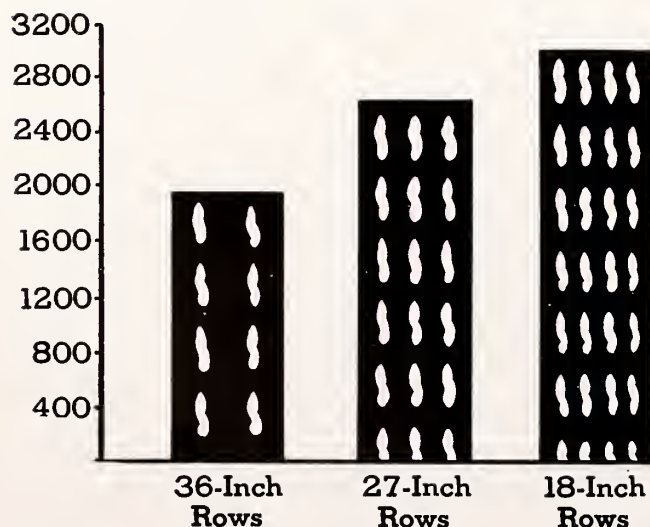
Narrower Rows Also Boost Yields

The importance of using narrow rows to obtain maximum yields of Virginia Bunch peanuts is shown in the accompanying figure. Normal rows, 36 inches wide, gave a much lower yield per acre than did either the 27-inch or 18-inch rows in a study conducted at Rocky Mount. The increased yield was far more than that necessary to pay the additional seed and cultivation costs of narrower rows.

Hay yields were also higher when the peanuts were planted in 18 or 27-inch rows. The addition of potash in this test increased the yield of peanuts whether the plantings were made in 18, 27 or 36-inch rows.

This experiment, as well as earlier experiments, points out the need for getting more plants per acre.

Yield In Pounds Per Acre



Austrian Winter peas, crimson clover and vetch, when used as cover crops preceding peanuts, brought yield increases of up to 400 pounds per acre as compared to "no cover" plots.

The use of narrower rows increased the yield of Virginia Bunch peanuts up to 1,000 pounds per acre.

Lime, Landplaster Prove Important For Fertilizing Peanuts

Experiments in the past have shown that calcium additions, either as lime or landplaster, have increased the filling of peanuts. Brady, Nelson and Reed, after studying peanuts from an experiment on sandy soil in Edgecombe County, now report second beneficial effect from calcium. Calcium increases the percentage of "pegs" that make shells—whether full or empty.

The experiment was in progress for two years, and the lime treatments were broadcast the first year only. The landplaster treatment was applied both years. Results of this study are shown in the accompanying graph.

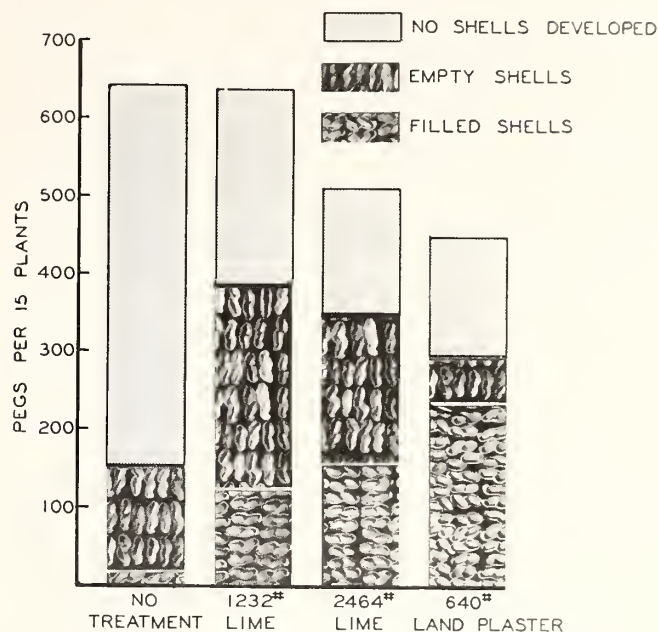
Although the plants from plots receiving no treatment produced more total pegs, most of these pegs did not develop shells. At the end of the season many pegs were diseased and rotton. Most of the shells which did develop were empty.

The addition of 1,232 pounds of dolomitic limestone increased the proportion of the pegs which developed shells, but many "pops" or unfilled peanuts resulted. Increasing the rate of lime to 2,464 pounds per acre produced a larger proportion of filled shells. Landplaster brought a further increase in the development of kernels.

The results emphasize the need for a high calcium level in the zone of peanut formation. On soils low in calcium, yearly applications of landplaster, or broadcast applications of lime are effective means of meeting the calcium requirements.

The three cotton-peanut rotation experiments which were begun in 1945 were continued this year. Results from the two soils lowest in calcium

NUMBER OF PEGS DEVELOPING
AS INDICATED



More peanut pegs developed when the soil received no treatment, but the proportion of filled shells increased rapidly as lime or landplaster was used.

showed a peanut yield increase from lime or landplaster applications. The lime treatment at both locations was also reflected in increased hay yields. Landplaster had no effect on the yield of hay.

Copper Residue On Peanut Hay Has No Ill Effects On Livestock

The copper residue on peanut hay, resulting from copper-sulphur dusting for leaf-spot control, is not toxic to livestock. James H. Jensen, W. J. Peterson and T. T. Herbert made these findings in recent analyses of peanut hay for copper content.

Random samples of plants dusted four times with sulphur, containing 2, 4 and 6 per cent copper (metallic basis), and with sulphur alone were analyzed. Plants from plots which had received no dust or only sulphur showed a copper content of about 15 parts per million. Plants dusted with copper-sulphate averaged 50 parts

per million, irrespective of the copper level of the dust.

Copper residue on dusted peanut plants varies widely with methods of application, climatic conditions, and time and number of treatments. Even so, there seems to be no likelihood that the copper content, even at the highest levels found, would be toxic to livestock.

Research work with livestock at other centers has shown that doses up to 80 grams of copper sulphate were not poisonous to heifers or adult cows. An animal consuming as much as 10 pounds daily of peanut plants with the highest levels of copper shown, would have an average intake of only .23 grams of copper.

New Peanut Harvester Picks Nuts Immediately After Digging

An experimental peanut harvester for use where the nuts are picked from the plants immediately after digging, has been developed by G. W. Giles. The machine will be used in connection with a dryer to reduce losses from present methods of field curing.

Bad weather, like that of 1947, often causes serious losses to the farmer while the peanuts are curing in the open. Giles believes a "once-over" green peanut harvester would reduce the labor and power needed for harvesting as well as save

more of the nuts. Other advantages are that it improves the quality of the nuts and results in better hay.

The improvement in the hay is mainly due to curing in windrows right after digging. The green plants could be chopped and dried to give a feed of high value, in which case the plant roots would be returned to the soil.

The harvester, as a whole, works well, Giles reports. However, the hay is not properly windrowed for pick-up after curing. The machine is being improved for further tests in 1948.

Green Peanuts Picked and Dried In Only A Few Hours

Green peanuts have been picked and dried artificially in a few hours time in experiments carried out by N. C. Teter in cooperation with the Georgia-Florida-Alabama Peanut Association.

There are several pickers which do a good job of picking freshly-dug peanuts. They take about half again as much time to pick green peanuts as for field-cured peanuts.

A tower-type dryer, intended for drying materials of a lower moisture content than green peanuts, can be adapted for peanut drying. Instead of feeding the green nuts in the tower continuously, the tower is filled and the peanuts completely dried before more peanuts are fed in. In other words, this steady flow dryer is used as if it were a batch dryer.

The best temperature for drying green peanuts of 35 to 40 per cent moisture content, begins at 100 degrees F. and rises to 120 degrees F. The input air temperature is kept at 100 to 105 degrees F. for the first 10 to 12 hours of drying. It is kept at 110 to 115 degrees F. for the next eight to ten hours, and at 120 degrees F. for the last three or four hours of drying.

An air flow of 40 cubic feet per minute (CFM) per cubic foot of peanuts is about right for good drying, with a tower dryer used as a batch dryer. The average cost for drying a ton of peanuts (dry weight) totals \$18.20. This includes depreciation, repair and maintenance, taxes, insurance, labor, power and fuel. A machine built for batch drying of peanuts would likely reduce this cost by 25 per cent.

Lemont Oats Resist Disease



LEMONT, the new variety of oats developed at the Station a few years ago, showed a high degree of resistance to *Helminthosporium* blight, in tests conducted by T. T. Herbert and G. K. Middleton.

The tests were under greenhouse conditions at the State College Station.

A comparatively new disease of oats, *Helminthosporium* blight has damaged susceptible oat varieties severely in the North Central and many southern states. Though it has not yet appeared in North Carolina, Hebert and Middleton are testing common oat varieties for resistance, in case the disease does invade the State. They do not yet know whether the fungus has never been introduced or whether conditions are unfavorable for its development.

A large proportion of the oat acreage in the State is now planted to varieties which are susceptible to the new disease. Letoria, Lega, Stanton, Victorgrain and Rust Resistant Fulgrain all proved to be susceptible in the tests. Fulghum, Lee and Fulwin proved resistant.

If *Helminthosporium* blight should become widespread in North Carolina, it may be necessary to abandon the susceptible varieties now grown in favor of these with resistance. For the past eight years at Statesville and for five years at McCullers, Lemont has produced the highest yield of all varieties tested.

Unfortunately these *Helminthosporium* blight resistant varieties are susceptible to rust. Breeding work is now under way to develop a locally-adapted variety which is resistant to both blight and rust.



These oat varieties were inoculated with *Helminthosporium victoriae*. Stanton and Victorgrain

are susceptible to this disease. Fulghum and Lemont are resistant.

McCullers Tests Substantiate Need for Early Seeding of Oats

Due to cropping practices or to weather conditions it is not always possible to seed oats early enough to obtain maximum yields. To secure information on the relative adaptation of varieties to late seeding Middleton and Hebert set up in the fall of 1945 an experiment involving all 49 varieties carried in the Experiment Station's advanced test.

This group of varieties was planted at the McCullers Station on October 10 and again on November 20. With no winter injury taking place that year, and an abundance of rain in the spring there was an average yield difference for all varieties of only five bushels. Four varieties produced significantly more grain from late seeding.

The test was repeated in the winter of 1946-47, using only 16 varieties and the seeding dates of October 14 and December 1. Under these conditions the average yield for the October seedings was 61.7 bushels per acre as against 31.4 for

December seedings. All varieties produced their best yields from early seedings.

A study of the yields for the two-year period supports previously published data that October seedings of oats usually produce better yields than when planting is delayed until late November or December. This was true of all locally-grown varieties with the exception of Fulwin, which produced equally as good yields from late as from early seedings. Yields of this variety from either early or late seedings were below those of all other locally-grown varieties.

The average yield drop in bushels per acre for the two-year period was: Victorgrain, 22.5; Fulgrain 3, 20.4; Lee 5, 20.2; Lemont, 19.5; Stanton, 18.8; and Letoria, 16.1. The experiment is being conducted again to get further information on why Fulwin, a late maturing variety, responds better to late seeding than does other varieties. The tests will also aim at finding the best variety to use when it is necessary to seed late.

New, Resistant Wheats Yield Better in Rust-Infected Areas

Tests conducted in the winter of 1946-47 by G. K. Middleton and T. T. Hebert, illustrated anew the importance of planting a wheat variety that is resistant to mildew and leaf rust.

Nineteen varieties, units of the Uniform Southeastern Wheat Nurseries, were grown at both Statesville and McCullers. At Statesville there was very little disease present. Carala and Leap, standard varieties in the Piedmont area, produced yields equal to those of Hardired 5 and a new disease resistant selection, No. 5450.

At McCullers, where mildew was severe and some rust was present, the story was quite different. Selection 5450 led the test with a yield of

35.0 bushels per acre, followed by Hardired at 33.0. In comparison, Leap stood 18th with a yield of 23.6 and Carala at the bottom of the group with 23.4 bushels. On a scale of 1 to 4 for susceptibility to mildew, these varieties were scored as follows: Selection 5450, 2; Hardired, 2 plus; Leap, 3; and Carala, 4.

Selection 5450 and a sister selection, No. 5466, have consistently yielded high in mildew and rust infected areas. Both have excellent straw and both are being increased for distribution to certified growers in the fall of 1948. They have produced good yields at both Statesville and McCullers for the past three years and in official variety tests for two years.

How Nitrogen Increases Grain Yields

The yield of grain produced by a wheat or oat plant is the end result of a number of factors acting together. W. H. Rankin has conducted several studies recently with the aim of determining how nitrogen increases yields.

Rankin now reports that nitrogen applications increase yields by increasing the following: (1) Number of tillers (branches) per plant and unit

area; (2) number of spikes (heads); (3) length of spikes; (4) number of spikelets per spike; (5) number of kernels per spike; (6) total height of plants; and (7) total weight of plants.

This information is useful in deciding when nitrogen should be applied. Since nitrogen increases the number of tillers, it should be applied before the tillers start forming.



This is one of several small grain demonstration plots located in the piedmont last year. It demonstrates the importance of such factors as date of planting, seed treatment, and proper fertilization.

Wheat Yields Higher In Spite of Mildew

The amount of powdery mildew on wheat is directly proportional to the amount of nitrogen used as a top-dressing in the spring, according to Hebert and Middleton. These findings were made in studies during the past two years.

Nitrogen applied at seeding time or during the winter did not greatly affect the development of powdery mildew. But in spite of the increase in mildew, the spring applications of nitrogen proved more profitable from a yield standpoint than those made earlier.

In 1947, experiments were planned to give some information on what yield increases might be obtained from nitrogen applications if mildew were not present. The disease was controlled in half

of the experimental plots by dusting with sulfur.

In some cases the yield increases obtained from spring application of nitrogen was twice as great where sulfur was used. For example, in one experiment the plots receiving no nitrogen yielded 16.2 bushels per acre undusted and 16.3 bushels per acre dusted. Those receiving 45 pounds of nitrogen (281 pounds of nitrate of soda) on March 1 yielded 24.3 bushels per acre undusted and 33.9 bushels per acre dusted.

The latter two figures also show the reduction in yield that may be caused by mildew infection. The results indicated that increases in yield now obtained by applying nitrogen would be even greater if mildew resistant varieties were available.

New Stiff-Strawed Barley Produces Bigger Yields Than Sunrise

Sunrise x Davidson-2989, a stiff-strawed, mildew-resistant barley selection, first showed its possibilities in a preliminary test in 1944 and in the Advanced Variety Test in 1945. During the past two years, Middleton and Hebert have had it on trial in a total of 15 tests, including Experiment Station and Official Variety tests.

As an average for these 15 tests, it has produced 41.4 bushels as compared with 35.2 for Sunrise. This is an increase of 17.5 per cent over the Sunrise parent.

Selection 2989 combines the mildew resistance of Sunrise and some of the rust resistance of Davidson. In 1945 and 1946, when rust conditions

were especially severe, it stood much better than did Sunrise. This new selection is being increased for distribution to certified growers in the fall of 1948.

In an effort to obtain better rust resistant varieties, crosses have been made between Boliva and Weider (resistant varieties) on the one hand

and certain local varieties on the other. The earliest selections made from these crosses were in preliminary tests in 1945 and 1946 and in an advanced test in 1947. Certain selections have consistently outyielded Sunrise and Davidson. They are being further tested for disease susceptibility before going into the Official Variety Tests or before being increased for distribution.

Koto, Dakota Lead in Flax Seed Yield Tests

Trials of an exploratory nature were conducted by W. H. Rankin in 1947 to determine the yields of seed flax that could be produced under Piedmont and Coastal Plain conditions. Six varieties were grown at four nitrogen levels.

At the Upper Coastal Plain Station the highest

yielding variety was Koto, which produced 12.2 bushels per acre. The lowest variety, Sheyenne, produced only 4.9 bushels. There were no differences in yields due to nitrogen treatments.

At the Piedmont Station the yields were higher but with less difference between varieties. Dakota produced 16.4 bushels per acre and Crystal 13.7.



Roanoke, Ogden Soybeans Excel

ROANOKE AND OGDEN continue to be the best adapted varieties for seed production, says E. E. Hartwig, in reporting the results of his 1947 variety tests.

For the five years, 1943 through 1947, Roanoke has surpassed other varieties for seed yield, seed holding, and oil content in the Upper Coastal Plain and Piedmont areas. During 1946 and 1947, Ogden gave higher yields than Roanoke on the poorly drained soils of the tidewater area. Both of these seasons were very wet.

Heavy Seeding Aids Weed Control

Control of annual weeds in soybeans is important both from the standpoint of yield and ease in combining. A heavy growth of weeds often requires waiting until a heavy frost kills the weeds before harvesting can begin. This delay often reduces the quality of the seed crop.

Hartwig has found that the important steps in weed control are: planting enough seed of an adapted variety, seeding in rows to permit cultivation, fertilizing to insure adequate growth, and proper cultivation. When good quality seed is planted at the rate of 10 to 12 seed per foot of row in a well-prepared seedbed, the beans will emerge uniformly and make rapid growth. With a thin stand weeds have a much better chance to become established, and it is difficult to kill them by cultivation.

When planted in 36-inch rows two or three cultivations are usually enough to control weeds. The increased amount of seed needed for planting solid and the hazards from weeds usually far overbalance the cost of cultivation.

Unless the soil is first limed and fertilized, weeds cannot be controlled as described above. With improper soil treatment the soybeans will not make enough growth to shade the ground and limit weed growth. Many of the weedy bean fields in the soybean-growing area can be attributed to improper soil treatment.

(Top) Soybeans planted at the rate of four seeds per foot. Note the open spaces in the row, giving weeds an opportunity to become established.

(Center) Soybeans planted at the rate of 12 seeds per foot. The good ground cover gives weeds little chance to become established in the row.

(Bottom) Soybeans planted at the rate of four seeds per foot (center) and 12 seeds per foot (bottom). The more rapid growth of the thicker planting permits earlier cultivation and shades out weed seedlings.





Soybeans planted solid with a grain drill. The crop was not cultivated and crab grass gained control of the field



Soybeans planted in 36-inch rows and cultivated to control weeds. Middles are completely shaded and weeds will not have a chance to become established.

Seed Treatment Increases Yield as Well As Stand

Having already demonstrated that treatment of soybean seed increases stands, S. G. Lehman carried his investigations one step further during 1947 to find that treatment of seed also results in increased yields.

Lehman conducted his tests on Norfolk fine sandy loam soil at the Upper Coastal Plain Branch Station, using seed of the Roanoke variety. When treated with Arasan this seed had an emer-

Soybean seed planted in Rows 1 and 2 was treated with Arasan before planting. Seed in Rows 3 and 4 was not treated.



gence in steamed sand of 97 per cent. Under the same greenhouse conditions, untreated seed had an emergence of 75 per cent.

In the field tests, one portion of the seed was planted without treatment. A similar portion was treated with two ounces of Arasan dust per bushel of seed before planting. Both treated and untreated seeds were planted at rates of four, eight and twelve seeds per foot of row. These rates are equivalent to 15, 30 and 45 pounds per acre.

Treatment with Arasan increased the number of plants which emerged and survived from 2.0 to 3.4 plants per foot of row where four seeds had been planted. The increase was from 3.7 to 6.3 plants where eight seeds had been planted, and from 5.2 to 9.9 plants where twelve seeds had been used.

The increased stands resulting from seed treatment were followed, in turn, by increased yields of seed. Where four seeds per foot had been planted, yields increased from 23.1 bushels per acre for untreated seed to 26.2 bushels for treated seed—a net gain of 3.1 bushels for treated seed. Where the seeding rate was eight seeds per foot the yield increase was 3.8 bushels per acre, and where twelve seeds had been planted 1.7 bushels.

The highest yields in this test occurred on the plots where four and eight treated seeds were planted per foot of row. One-twenty-fifth of a bushel of soybeans will pay for enough material to treat the seed needed to plant one acre.

Slurry Method Effective

In further tests of methods for treating soybean seed, Lehman found that Arasan may be safely and effectively applied by the new slurry method.

A comparison of the dust treatment (regular Arasan) with the moist-slurry treatment (Arasan SF) was made. The two preparations were mixed at such rates as to add the same amount of active ingredient to the seed. Increases in germination

and emergence of the treated seed were essentially the same for both.

In these tests Arasan, in either form, continued to give slightly better protection to soybean seeds than any other material. Lehman believes that if the applications are made with proper attention to details, the two methods may be used with reasonable assurance of equal benefit. The slurry method has the slight advantage of eliminating the dustiness which some growers object to.

Soybeans Respond to Dusting For Disease Control

Soybeans are attacked by a number of bacteria and fungi that damage leaves, pods and stems. S. G. Lehman has for several years been studying the control of these diseases by the application of fungicidal dusts. During 1947 he culminated his tests by demonstrating that dusting actually increases yields.

Replicated plots of the Ralston, Ogden and Roanoke varieties were treated with a dust consisting of 7 per cent copper, 3 per cent DDT, 10 per cent wheat flour and 80 per cent Cherokee Clay. Control plots received the same dust without the copper.

Six applications of the dust were made, beginning on July 18 and continuing at approximately ten-day intervals. The length of the interval depended on the amount and frequency of rainfall following each application. The last application was made on August 27. At that time flowering had ceased and most of the pods were mature size though not fully swollen. The dust containing copper was used at approximate rates of 30, 60, and 90 pounds, and the dust for the control plots at 60 pounds per acre per application.

Two weeks after the last dust application disease ratings showed disease damage to the check plots amounted to 2.4 per cent of the leaf area. In contrast the 30, 60, 90-pound applications of the copper dust reduced bacterial leaf damage more than 50 per cent. Five weeks after the last dust application control plots showed 27 per cent diseased leaf area, whereas treated plots showed 15 per cent or less. An observer could readily identify the plots dusted with copper by the greener and more healthy appearance of the foliage.

The mean yield of the three varieties in the control plots was 27.0 bushels per acre. The plots receiving the 30, 60, and 90-pound applications of copper dust yielded 32.5, 32.5, and 32.7 bushels, respectively. Thus a yield increase of 5.5 bushels per acre resulted from including copper in the dust.

Other data collected from this test indicate that the basic yield of the dusted plots may have been reduced somewhat by the type of carrier used in the dusts. Further tests are needed to determine if this is true and if satisfactory carriers may be found before a general recommendation for dusting soybeans is made.

Liming Boosts Soybeans Yields Up To Seven Bushels Per Acre

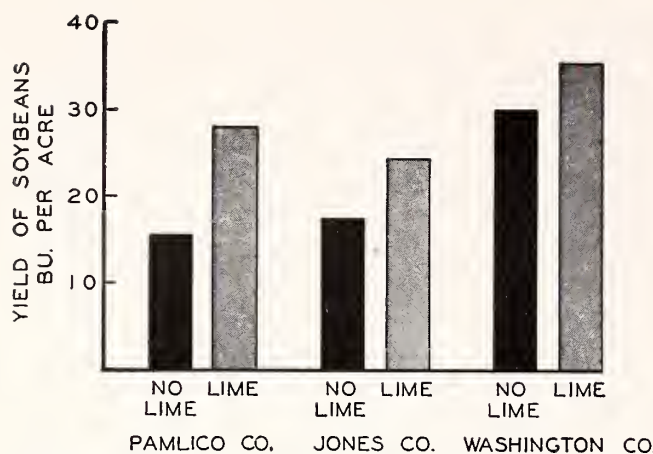
In summarizing the results of three years' experiments with soybean fertilization, W. L. Nelson and C. D. Welch report an average yield increase of slightly more than seven bushels per acre as a result of liming. The tests were conducted at three locations in Pamlico, Jones and Washington counties.

Phosphate and potash were supplied in adequate amounts in all of these experiments. Soils vary greatly in their lime requirements. Nelson sug-

gests that the soil be tested to determine the exact amount of lime needed.

Soybeans do not benefit from nitrogen applications. Nelson reports this finding after conducting experiments at several locations since 1945.

In each test, nitrogen was side-dressed as ammonium nitrate on plots which had received four different rates of lime. The results show that soybeans can secure their nitrogen from the air in sufficient amounts when they are limed and supplied enough mineral fertilizers.



Liming is one of the important practices in raising soybeans.

What effect, if any, does the minor elements have on soybean yields? In view of his work on liming and fertilizing soybeans, Nelson thought it desirable to determine the answer to this question during his 1947 experiments.

A mixture containing iron, boron, zinc, copper and manganese was applied to the test plots. In two experiments on dark soils, yields were increased on plots that had received high rates of lime. On lighter colored soils, Nelson obtained no responses.

The investigator, however, learned a remedy for the manganese deficiency that is very common on the sites of old lime piles: broadcast applications of sulfur at the rate of two to five hundred pounds per acre.

Five Per Cent DDT Dust Controls Most Soybean Insects

Soybean insect pests were again numerous in 1947, according to Walter M. Kulash. Early season investigations showed that the usual crop of velvetbean caterpillars and earworms was followed by an early outbreak of fall armyworms. This was particularly true on late-planted beans of the southern coastal plain area where armyworms were present in late August. One dusting of 5 per cent DDT was enough to bring the early outbreaks of armyworms under control.

Field examinations in Hyde and Tyrrell counties in late July showed that it was too early for the major leaf-eating caterpillars. However, there was an abundance of the grape Colaspis, beanleaf beetles, and cucumber beetles on young as well as

on old beans. Beanleaf beetles increased in numbers as the season progressed.

In Currituck, Perquimans, and Pasquotank counties the leaf beetles were very abundant and caused considerable damage on many farms during late August. By early September, the velvetbean caterpillar appeared in Hyde and Tyrrell counties as did the corn earworm.

Over 40,000 pounds of 5 per cent DDT dust were used on 2,500 acres of late beans in Hyde County alone in 1947. The use of DDT on soybeans in this county presented no residue problem since the beans are used as seed. Where beans are to be used for hay, DDT applications are not advised later than six weeks before the time of harvest.

Fertilize For Leaf Quality



IN A NEW PROJECT, initiated early in 1947, W. E. Colwell, W. G. Woltz, and W. A. Reid began a study of the effect of fertilization on the chemical composition and quality of cigarette tobacco.

One of their first lines of investigation was to find an answer to the recurring question, "How much nitrogen should be used in fertilizing tobacco?" Since flue-cured tobacco is grown primarily for use in cigarettes, fertilization practices should favor the production of cutters and lugs rather than heavier leaf grades.

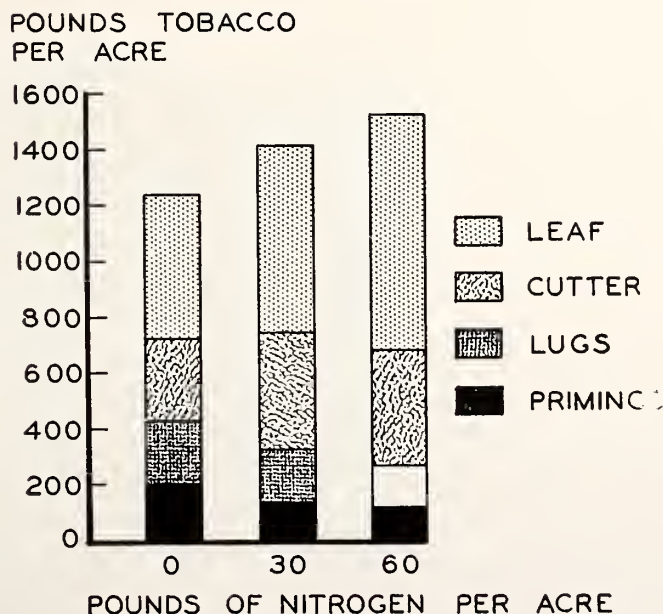
The effects of added nitrogen on the production of the different grade groups are shown in Figure 1. It will be noted that moderate amounts of nitrogen increase the amount of tobacco in the cutter grades. However, when the nitrogen rate reached about 30 pounds per acre, the resulting yield increase becomes due entirely to the increased weight of the heavier leaf grades.

Figure 2 shows that value per acre increases only slightly when the nitrogen rate goes beyond 30 pounds per acre.

Sugar Content High In Better Leaf Grades

One of the essentials of a good flue-cured cigarette tobacco is that it contains a high percentage of sugar. The studies by Colwell, Woltz and Reid

The proportion of heavy leaf grades increases, while the proportion of primings and lugs goes down, as more nitrogen is used on tobacco.

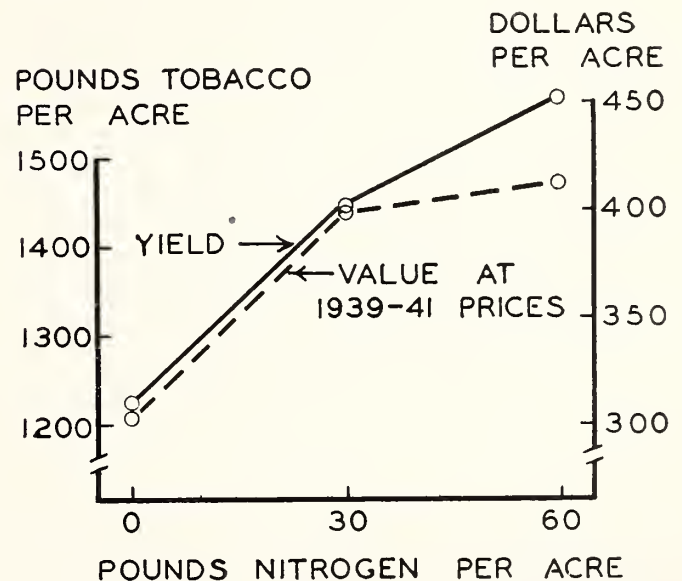


show that much of the drop in quality caused by over-fertilization may be due to a drop in sugar content.

In experiments located near Rocky Mount and at Oxford, heavy applications of either potash or nitrogen decreased the average sugar content of the leaves.

The sugar content of the lugs and cutters proved to be considerably higher than that of the leaf grades. Fertilization had little effect on the sugar content of any particular grade. Thus the low sugar content of tobacco grown with large amounts of nitrogen is due largely to the high proportion of leafy tobacco produced under this treatment.

Added nitrogen may increase the yield of tobacco, but beyond a certain level (in this case 30 pounds per acre) it does little to increase the value of the crop.



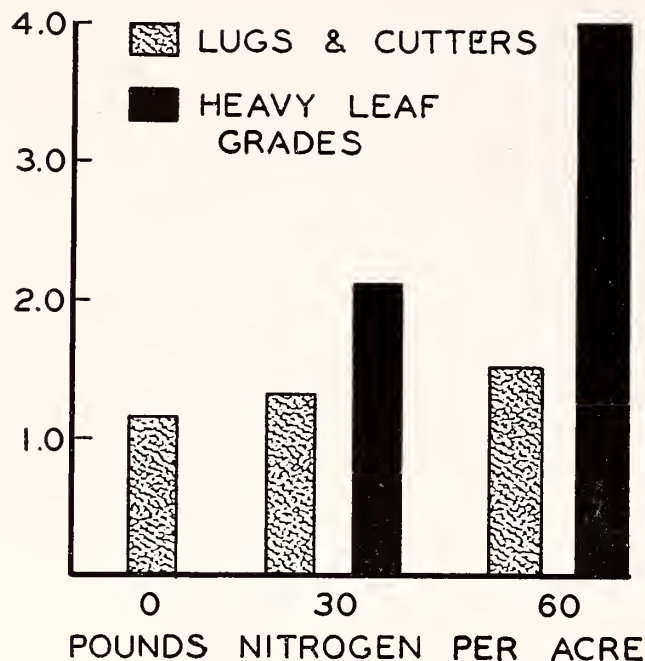
Heavy Grades Contain More Nicotine

If the nicotine content of tobacco is too low (less than about one per cent) the smoker does not get the desired satisfaction from the smoke. If it is too high (above about 2 to 2.5 per cent) the smoke becomes objectionable and irritating.

Colwell, Woltz and Reid have shown that the rate of nitrogen fertilization influences nicotine level in tobaccos. They report further that nitrogen affects the nicotine content of one grade group more than another.

A summary of their findings is shown in Figure 3. The nicotine content of the lugs and cutters increased slightly with the addition of fertilizer

PER CENT NICOTINE



Added nitrogen increases the nicotine level in tobacco, especially in the heavy leaf grades.

nicotene. However, even at the high rate of nitrogen (60 pounds per acre), the nicotine level did not exceed the limit considered good for flue-cured cigarette tobacco.

On the other hand, the nicotine content of the thick, heavy-bodied tobacco was considerably higher. It increased rapidly with the addition of nitrogen, reaching a level near 4 per cent.

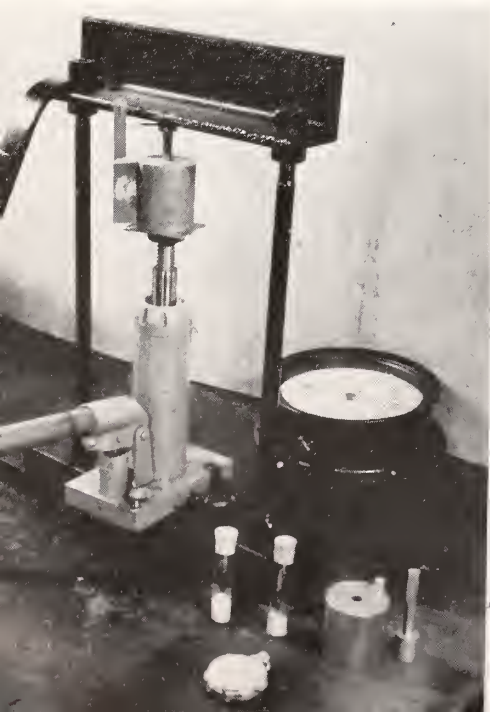
Rate Of Burning Measured With New Methods

Burning is an important property in tobaccos used for smoking purposes. Heretofore, techniques for measuring burning properties and the effects of fertilization practices on burning have been relatively crude. It has been impossible to determine with precision the influence of one or the other elements upon either rate or completeness of burning.

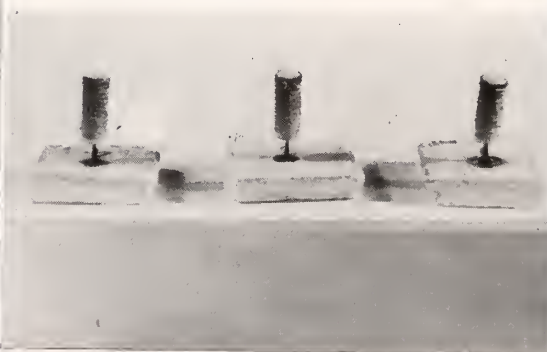
Accordingly, studies were made to develop new and better techniques. In one method tobacco is ground and made into a small pellet holding 0.7 gram tobacco, compressed by means of a hydraulic jack (Figure 4). The pellet is then ignited by electric current, and the time required to burn the tobacco under normal conditions is measured. Figure 5 shows the appearance of the burned pellet.

In a second technique, a cigarette is made from the experimental tobacco, care being taken to employ standard cigarette paper. As shown in Figure 6, the ground tobacco is used to fill the cigarette through a funnel. The entire apparatus is placed on an electric vibrator to insure equal packing. The cigarette is lit and measurements made on rate and nature of the burn.

Results of these studies are used in making fertilizer recommendations for producing tobacco with good burning quality.



Figures 4, 5, and 6: Pellets, used in the combustion studies, were made from ground tobacco with the equipment shown at the left. The pellets are shown below as they appeared after combustion. The apparatus on the right was used to make cigarettes for the burning studies.



Bright tobacco curing tests are being carried out in eight new barns at the Oxford Branch Station.



Improved Tobacco Barns Save Up To 75 Per Cent In Curing Costs

By improving the heating system, insulating the barn walls and ceiling and controlling drafts and ventilators more carefully, O. A. Brown and N. W. Weldon have been able to save up to 75 per cent of the fuel costs in curing tobacco. These curing tests were conducted at the Oxford Branch Station.

Records kept on one curing barn during the 1946 season show that it used a total of 2,404 pounds of coal. After improvements were made the following year, the same barn required only 619 pounds of coal. Another barn, equipped with an oil curing unit, used only 50 gallons of fuel when operated under the improved system. A wood-burning unit was operated on as little as 2,520 pounds (0.7 cord) of air-dried wood.

On the basis of these tests, Brown and Weldon now say that the heat from a pound of coal should be enough to cure a stick of tobacco under average weather conditions at Oxford. A gallon of No. 3 fuel oil should cure ten sticks; a gallon of propane

gas, six and three-quarter sticks; and two pounds of air-dried wood, one stick.

The two workers add further that North Carolina farmers are using twice the fuel needed to cure the tobacco crop. About one billion sticks of bright leaf tobacco were cured in the United States in 1946. Had all this been cured with coal (the cheapest fuel) it would have amounted to about one million tons. More than five million dollars could have been saved for tobacco farmers by cutting the fuel use in half.

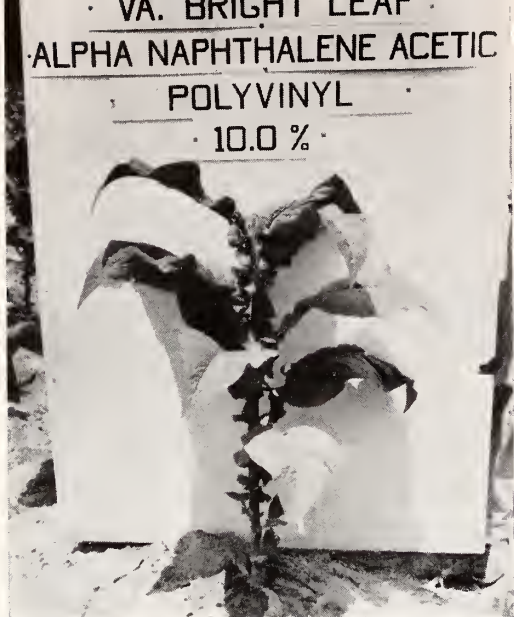
Tobacco curing research was expanded during 1947 with the addition of eight new tobacco curing barns, four of which were built under cooperative agreements with industries. The engineers have now perfected a wood-burning furnace which gives controlled heat. Coal-burning furnaces are now built to deliver more heat to the curing barn and spread the heat more evenly within the barn. The workers are also improving oil burning equipment and trying out hard coal as a curing fuel.

Growth Chemicals Prevent Sucker Development

When tobacco is topped, suckers develop rapidly, and their removal by hand is a tedious operation. In field experiments during 1947 at the McCullers Branch Station, D. B. Anderson suc-

cessfully inhibited sucker development with applications of 5 per cent or more of alpha naphthalene acetic acid.

Anderson explains that the tobacco plant forms growth substances, often called auxins



or hormones, in the terminal bud. So long as the top remains on the plant, these hormones prevent suckers from growing. When the plants are topped, however, the supply of hormones is destroyed and suckers develop quickly. Growth substances in the form of chemical compounds are used as substitutes for the naturally-occurring hormones.

Conducts Preliminary Tests

Before taking the experiments into the field, Anderson conducted preliminary greenhouse tests to determine which chemicals, if any, showed promise. The chemicals were mixed with a "carrier" such as lanolin, polyvinyl alcohol or mineral oil and applied to the freshly exposed stem tip immediately after breaking out the top.

Virginia Bright leaf and 402 were used in the McCullers field test. Three weeks after topping the untreated plants had suckers three to four feet long. Where suckers were present on the treated plants, they were very few and greatly reduced in size. The methyl ester of alpha naphthalene acetic acid was also effective in reducing sucker growth on the same two varieties.

Experiments To Continue

Indole acetic acid was fairly effective on 402, but less effective on Virginia Bright leaf. Indole butyric acid was relatively ineffective, and indole propionic acid did not check sucker growth in any of the concentrations used.

At a Surry County location, where companion tests were conducted, the treatments were, in general, less effective than they were at McCullers. The chemicals were applied just about the time a severe drought was broken, and growth was extremely rapid following treatment. The chemicals did not seem to enter the plant readily.

Further studies are being undertaken at various locations in the State in an attempt to develop a practice that can be followed by tobacco growers. These studies aim at evaluating such factors as varietal differences, fertility level, climatic factors, method of application and influence on tobacco quality.

Sucker growth was inhibited (top) by concentrations of 5 to 10 per cent alpha naphthalene acetic acid. Suckers developed normally (center) where no growth substance, but only the neutral carrier, lanolin, was used. Growth substances for the control of suckers cause a swelling of the end of the stem (bottom) where they are applied. This abnormal growth of the stem does not interfere with leaf development.

Greenhouse Permits Year Around Work on Disease-Resistant Lines

During the summer of 1947 E. L. Moore made a hundred and sixty-five crosses between varieties or strains of flue-cured tobacco at the Oxford Station.

Sixty of these crosses involved wilt and black shank resistance from both parents; 20 involved either wilt or black shank resistance from both parents; 75 involved wilt and black shank resistance from one parent and either black shank or wilt resistance from the other; 4 involved black shank resistance from one parent; and 6 involved wilt resistance from one parent. The object of these crosses is to develop improved varieties with wilt and black shank resistance.

The first or F_1 hybrid generation, which was relatively uniform in its characteristics, was grown in the greenhouse during the winter of 1947-48. In the spring of 1948 the second or F_2 generation was planted in the field in wilt or black shank-infested soil, depending on the nature of the cross. Many plants undoubtedly will die from one or the other of these diseases. Those



Shown here are some of the one hundred and sixty five F_1 lines of tobacco, growing in the greenhouse at Oxford, December 18, 1947. The hybrids are from parental lines having wilt or black shank resistance.

plants endowed with the greatest amount of resistance will be healthy and only the healthiest plants of best type are selected for seed.

Growing the first hybrid generation in the greenhouse takes the place of a field planting and makes it possible to grow the second or F_2 generation in the field the year after the cross is made. The time required for development of new resistant varieties is thereby shortened by one year.

Soil Fumigants Appear Effective on Root Knot, Meadow Nematode

Root knot and meadow nematode, two troublesome tobacco diseases, may eventually be controlled by D-D, Dowfume W-40, or other soil treatment materials. F. A. Todd tried out these two materials in tests at McCullers Branch Station and found that both effectively reduced the amount of root knot and meadow nematode as compared with the untreated check.

On land that had been continuously cropped to tobacco, both D-D and Dowfume W-40 were applied 90 days before planting. The rate was 200 pounds and 20 gallons per acre, respectively. The incidence of the two diseases under study as well as the yield and quality of tobacco were recorded.

Plots receiving D-D treatment produced at the rate of 1,449 pounds, valued at \$676.10 per acre. Dowfume W-40-treated plots produced at the rate of 1,376 pounds, valued at \$635.30. The untreated

check plots produced only 1,050 pounds, valued at \$500.40 per acre.

The effectiveness of the D-D soil treatment was also tested in a two-year crop rotation experiment. The rotation had been under investigation for 10 years before treatment was applied. It included cotton, corn, peanuts, oats-weeds and weeds as the crops grown between tobacco crops. One-half of each of the rotation plots was treated with D-D at the 200-pound rate 90 days before setting.

Although the D-D treatment reduced the severity of both root knot and meadow nematode in all rotations, it had little effect on the total yield and value in the corn-tobacco, cotton-tobacco and peanuts-tobacco rotation. Marked differences were found in the oats and weeds-tobacco, and weeds-tobacco rotations in favor of soil treatment.

The effects on quality were not quite so en-

couraging. Tobacco from plots receiving chemical soil treatment was thicker and just a little darker than leaves from the untreated check.

Since these results indicate that the treatments

may affect quality, soil fumigation may be practical only under conditions of high nematode infestation. Further testing is necessary before recommendations can be made.



In the picture on the extreme left, the check plot received no treatment for root knot, while the treated plot received 200 pounds of D-D per acre. The picture on the right, taken two months after harvesting, shows tobacco roots from untreated (left) and treated (right) soils.

Resistance to Black Root Rot Studied in Tobacco Breeding Program

G. B. Lucas is also finding the greenhouse a valuable aid in his black root rot studies.

In making such tests for black root rot resistance, Lucas collected soil from farms in three different counties where the disease is prevalent. During the winter of 1946-1947 at the Oxford Station he tested six different varieties of tobacco for their resistance to black root rot when grown on each of these three soils. The varieties were also grown on steam-sterilized soil inoculated with a pure culture of the organism that causes black root rot. Check plantings were made in steam-sterilized soil which was not inoculated.

Gold Dollar was highly susceptible to the disease on both naturally- and artificially-infested soils. Other varieties were highly resistant while some were intermediate. To confirm greenhouse trials the same varieties were grown during the summer of 1947 in fields where black root rot was known to be present. The varieties showed the same order of resistance in the field as in the greenhouse trials.

This information will be valuable in the "overall" program of breeding for disease resistance



These seedlings of Gold Dollar were grown under varying conditions. The largest plant was grown in sterilized compost. The next three were grown in soil from black root rot-infested fields. The smallest plant on the right was grown in sterilized compost which had been inoculated with the fungus responsible for black root rot.

where it is necessary to have varieties with resistance to more than one disease.

Dithane, Karbam Effective Against Blue Mold

Dithane Z-78 and Karbam, two new fungicides, were as effective as Fermate for controlling blue mold in tests at McCullers Branch Station and two other locations.

F. A. Todd found that all treatments gave adequate blue mold control when compared with the untreated check plots. After trying several different dust and spray concentrations of each ma-

terial, Todd found that the following gave equally good results: Dithane Z-78 spray (three pounds per 100 gallons); Dithane Z-78 dust (15 per cent); Karbam spray (four pounds per 100 gallons); and Karbam dust (15 per cent); as compared with Fermate spray (four pounds per 100 gallons); and Fermate dust (15 per cent).

There was no evidence of injury to the plants.

Fusarium Wilt-Resistant Lines Perform Well in First Tests

FIELD PERFORMANCE OF FUSARIUM WILT RESISTANT LINE
COMPARED WITH 402 AND OXFORD 26

Variety	Per cent of Plants Showing Field Symptoms	Total Yield in Pounds Per Acre		
		Fusarium wilt infested soil	Disease Free Soil	
		Whiteville	Oxford	Rocky Mt.
McCullers 27	16.6	1312	1637	1853
402	96.4	861	1585	1795
Oxford 26	20.8	1180	1300	1476

New tobacco varieties with bred-in resistance to Fusarium wilt have shown good commercial possibilities, according to F. A. Todd. Todd reports that when he started the tests at McCullers Branch Station and at Whiteville, North Carolina, three years ago, there were several highly resistant varieties available, but they were very poor from the standpoint of yield and quality.

First step in the breeding program was to cross some of these resistant varieties with common varieties noted for yield and quality. The most outstanding of the crosses so far is one in which United States Department of Agriculture Plant Introduction Number T. I. 566 was crossed with Gold Dollar and backcrossed to 401.

This new strain showed high resistance, good yield and high quality at McCullers in 1945 and

McCullers and Whiteville in 1946 and 1947. In 1947 it was also included in the variety tests at the Oxford Branch Tobacco Station, and the Upper Coastal Plain Experiment Station. At both locations, high yields of fair to good quality tobacco were produced.

In field appearance, this line of tobacco is slightly "off type." The plant is tall and the leaves are wide spaced on the stalk. The individual leaves are long and wide and tend to drop downward at the margins.

Tobacco from this strain tends to cure green unless it is full ripe when harvested. If properly primed the cured tobacco is very bright, ranging in color from bright lemon to bright orange. The upper primings cure extremely bright compared to other varieties of tobacco.

Station Establishes Research Farms in Pitt, Forsyth Counties

Two experimental farms, each containing approximately 20 acres of plot land, have been leased by the Station as a part of the expanding tobacco research program. According to W. E. Colwell, the two farms now permit tobacco research under soil and climatic conditions not previously represented by experimental facilities.

One farm, designated as the Lower Coastal Plain Tobacco Research Farm, is located in Pitt County two miles south of Greenville. It includes areas of Norfolk Fine Sandy Loam, Dunbar Fine Sandy Loam and Bladen Fine Sandy Loam, soil types common to the tobacco-producing area of the Lower Coastal Plain.

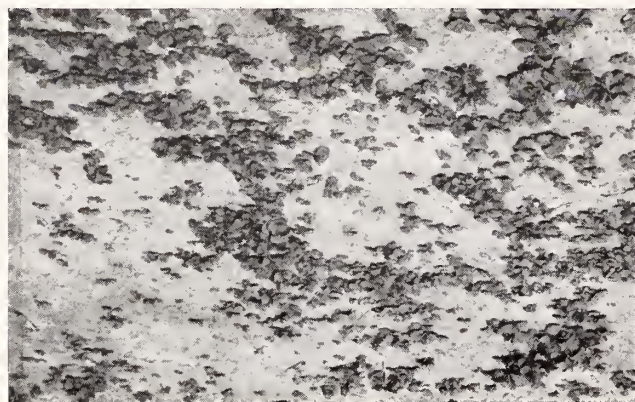
Experiments at this farm will be conducted on plant bed management, cropping systems, fertilization, insect control, variety testing and tobacco diseases. During the first season emphasis is on testing of varieties resistant to black shank and

Granville wilt. These two diseases are becoming quite widespread in the area served by this farm.

A similar farm, designed to serve the Upper Piedmont Tobacco area, has been located in Forsyth County, adjacent to the city limits of Rural Hall. The predominating soil types on this farm are Cecil Clay Loam, Cecil Loam, Cecil Sandy Loam. Approximately three-fourths of the tobacco in the Upper Piedmont counties is produced on these types of soil.

Emphasis at this station will be on plant bed management, fertilization studies, including placement and using the radioactive isotope of phosphorus, spacing, topping, and variety testing. Particular attention will be devoted to the production of so-called "cigarette tobaccos" and black shank resistant lines. The over-all management of this farm, which is typical of many tobacco farms in the region, will also be emphasized.

Weed Control Measures Assure Hardier Tobacco Plants



The tobacco plant bed in the center received $\frac{1}{2}$ pound of uramon and $\frac{1}{4}$ pound of Cyanamid per square yard or one half the normal treatment for weed control. The bed below received the normal treatment, and the inset above received no treatment. All three had received normal treatment for one or more preceding years.

Under extremely unfavorable transplanting conditions, a higher percentage of tobacco plants from Uramon-Cyanamid treated beds survived transplanting than did plants from untreated beds. F. A. Todd made this finding in tests at the McCullers Branch Station.

Of the plants from treated beds, 87 per cent lived, while only 57 per cent of the plants from untreated beds survived transplanting. Treated beds had received the normal application of one pound Uramon and one-half pound Cyanamid per square yard.

In a companion tests under ideal transplanting conditions, plants from both treated and untreated beds gave perfect stands. Todd emphasizes that these results are for only one year's test.

Half Of Normal Rate Gives Good Results

After conducting weed-control tests in tobacco plant beds at the McCullers Branch Station, F. A. Todd reports that it may be possible to reduce the Uramon-Cyanamid application rates on beds that have received the normal treatment for one or more years. The regular rate is one pound Uramon and one-half pound Cyanamid per square yard.

In his tests, Todd compared two reduced rate treatments with the regular rate and an untreated check, all on tobacco beds which had been treated the previous year. All treatments were superior to the untreated check. The rates of three-fourths and one-half the regular rate were equal to the full rate in controlling weeds. However, more plants were produced on beds receiving the full combination treatment.

Todd advises caution in reducing the rate of application. He explains that the McCullers test was conducted on sandy soil and under ideal conditions for weed control. Since no tests have been made on heavier soil, the pathologist feels that the full rate may be necessary.

DDT, Cryolite Protect Tobacco Plants From Flea Beetles

Either DDT or cryolite can be used as a dust to protect tobacco plants from flea beetle injury, reports Walter M. Kulash.

A dust containing 5 per cent DDT or one composed of cryolite (70-80 per cent sodium fluoaluminate) may be applied during the early development of the plants in the plant bed and again just

before the plants are drawn for transplanting in the field.

Kulash has found these dusts to be effective under conditions encountered on the average farm. He reports that DDT has usually been effective over a slightly longer period of time than has cryolite.

Priming Increases Burley Yields Up To 300 Pounds Per Acre

Experiments with burley tobacco conducted during the past three years at the Mountain Branch Experiment Station, show distinct increases in yields from one and two primings made from the bottom of the plant.

In tests conducted by Luther Shaw, from one to four leaves were removed from each plant at each priming. The exact number pulled depended upon ripeness and degree of firing. Two primings resulted in increased yields, ranging from 200 to 300 pounds per acre.

The value of this increased poundage was from four to five times greater than handling costs at current tobacco labor prices. The results show that priming is definitely more profitable under dry weather conditions than it is during wet seasons.

Method of Stringing Effects Houseburn

The common practice of placing burley tobacco on racks in the field for several days before putting it in the curing barn has two very definite advantages, Shaw finds. Wilted tobacco takes less space in the curing barn, and it is less likely to houseburn.

The specialist adds one note of caution. If the wilted tobacco is caught in twelve to twenty-four hours of rain, severe damage will result. The leaves will be discolored and of inferior quality after curing.

The method of placing primed burley tobacco leaves on the stick is very important in relation to the amount of houseburn that may occur during the curing process.

This relationship has been clearly demonstrated in an experiment carried on for the past three years by Shaw. Varying numbers of leaves per hand were strung on sticks by the conventional stringing method used in housing flue-cured tobacco. The results shown in the accompanying graph demonstrate that as the number of leaves per hand was increased from one to five, the percentage of houseburn increased rapidly.

When more than one leaf was in a hand, the leaf arrangement also had an influence on houseburn. By arranging the leaves in groups of two, face to face in the hands rather than booked, the amount of houseburn was reduced. The face-to-face leaf arrangement evidently permitted better air movement among the strung tobacco leaves than did the booked arrangement.

Enforced Ventilation Reduces Houseburn

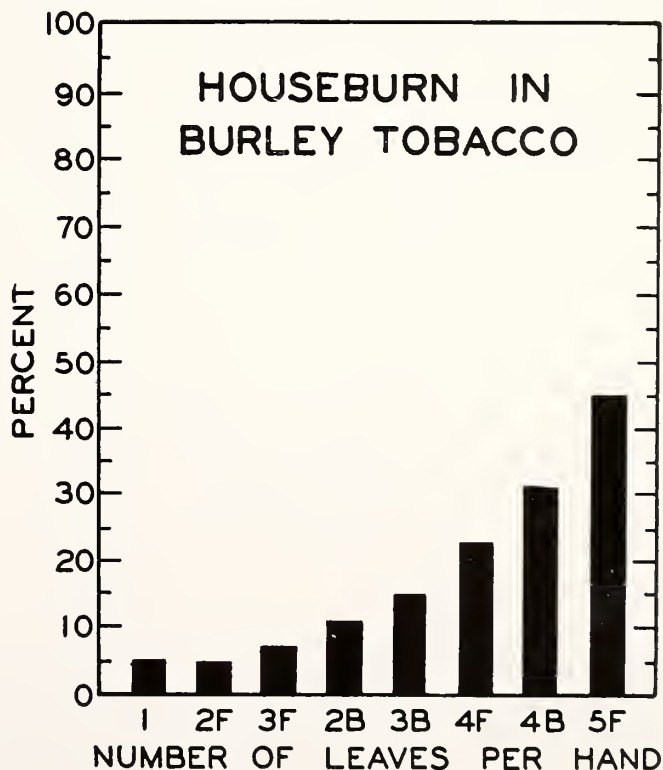
An enforced ventilation system, installed in one of the burley tobacco barns at the Waynesville Station for the 1947 season, showed great promise as a means of reducing houseburn.

With some modifications, Shaw patterned the system after the barn haydryer, installing a fan and an air duct system. The barn in which the installation was made had a volume of approximately 25,000 cubic feet and held between 4,000 and 5,000 sticks of cut tobacco. The fan was operated at a speed to deliver approximately 24,000 cubic feet per minute.

During the 1947 curing season, this enforced ventilation system was operated both intermittently and continuously during periods varying greatly in relative humidity. Of particular interest was the capacity of this system to keep air moving through the loaded barn at a moderate rate. Furthermore, by operating the fan it was possible to keep the relative humidity around 75 to 80 in the barn during periods of 100 per cent outside.

An adjacent barn of the same size was ventilated by opening and closing ventilators at the base of the walls and in the comb of the roof. Considerable houseburn was found in tobacco cured in this barn, whereas only a minor amount was found among tobacco cured by forced ventilation.

The number of leaves per hand and the leaf arrangement in the hands has a lot to do with the amount of houseburn in cured, primed burley tobacco.



F = LEAVES FACE TO FACE IN HANDS. B = LEAVES BOOKED IN HANDS.

A black and white photograph of a flowering orchard, likely cherry or almond trees, with a white rectangular text box overlaid in the upper left. The trees are in full bloom, with many small white flowers visible on dark branches. The background shows a field and a cloudy sky.

Horticultural Crops

Root Rot Attacks Orchards



ARMILLARIA ROOT-ROT by the fall of 1947 had killed almost one-half of the peach trees in a six-year-old survey orchard, according to C. N. Clayton.

The orchard was planted on newly-cleared land in 1941 and has been examined for the disease once or twice each year since. At each examination the dead trees were pulled and their roots examined to determine possible causes of death. Of the 490 trees in the orchard, 15 were removed in 1945. Fourteen of these had been killed by root-rot.

In 1946, 72 more trees were dead. Of these, 71 had root-rot, and 69 were considered killed by this disease. By the fall of 1947, 42 more trees

dead and 89 were badly infected. Thus, in approximately 30 months a perfect stand of trees had been reduced to about 55 per cent.

What happened in this survey orchard is not an exception, but is somewhat representative of what happens when peach trees are set on newly-cleared land. The fungus, *Armillaria mellea*, is able to grow for many years on pieces of buried root or wood. Roots of peach trees planted in soil containing this fungus are often infected.

Trees less than three years old are rarely killed by root-rot. The chance for infection increases as the trees grow larger and the soil becomes well permeated with peach roots.

No economically practical control for *Armillaria* root-rot is known. Once a tree is infected there is no known cure. The most logical step is

Right, above: A six-year-old healthy peach tree.

Left, below: An adjacent *Armillaria* root-rot infected tree.

Right, below: Mushrooms of the root-rot fungus, *Armillaria Mellea*, at the base of a seven-year-old peach tree.



to plant peach trees on non-infested land. A long-time crop rotation probably would be effective. However, in the Sandhill area of North Carolina the root-rot fungus has been found alive in buried pieces of old peach roots as much as six years after the trees were removed. The disease has

been found in old oak roots 12 years after the land was cleared.

Soil treatments that are effective cost around \$300 per acre and are too expensive to be practical. Clayton is continuing work on soil treatment, crop rotation, and resistant rootstock.

"Resistant" Lines Found Susceptible to Some Races of Nematodes

Shalil and Yunan varieties of peach are generally considered to furnish understocks which are resistant to nematodes, causing root-knot. However, in 1947 C. N. Clayton uncovered evidence that these rootstocks are susceptible to a certain race of nematode.

Seeds or seedlings of two susceptible rootstocks, Lovell and "Natural," and of the two resistant varieties, Shalil and Yunnan, were

planted in greenhouse pots. The soil had been taken from five different peach orchards.

In soil from two of the orchards, all four rootstocks and S-17 Flowering Peach (a resistant selection) as well, were equally susceptible. In soil from the other three orchards only the Lovell and "Natural" seedlings were susceptible. This test offers evidence that some soils are infested with a root-knot nematode race capable of infecting the so-called resistant stocks.

Thorough Wetting, Frequent Applications Needed To Control Curculio

Benzene hexachloride was used by C. F. Smith in further tests for the control of plum curculio. Results served to emphasize the need for three to five applications at from five to seven days apart.

The chemical gives the best results when the tree is thoroughly wet with the spray, using approximately three gallons of material. There should be a heavy enough drop to wet the soil beneath the tree.

Benzene hexachloride was used within a week of harvest time without causing any detectable flavor in the fresh fruit. However, there was a slight off-flavor in peaches canned from trees receiving five application—the last application ap-

plied one week before harvest. The flavor resembled that obtained when peach kernels are included in the normal process of canning.

Many growers used the stationary boom type sprayer, with the equivalent of a No. 6 disk in the nozzle. The amount of wormy fruit was considerably less during 1947 than in 1946—mainly because of the improved control program.

Cryolite was tried out as a petal fall spray, but in some cases it was delayed so that some of the spray reached the small peaches. Many growers used hexaethyl tetraphosphate in conventional ground machines, fog machines or airplanes. In all cases the results were very erratic. Satisfactory



Spraying with a stationary boom-type sprayer.

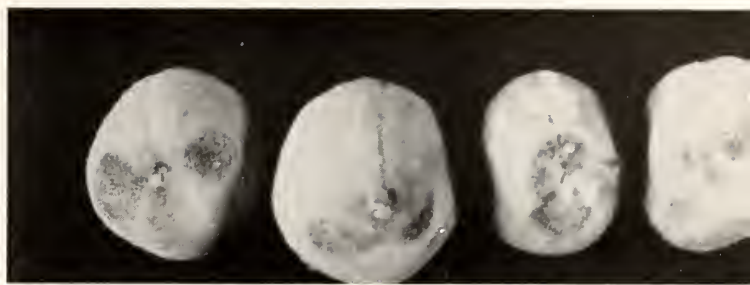
results could be duplicated only when it was used at the rate of 1½ pints per acre. The chemical is very poisonous to man and may also injure the foliage or fruit of peaches.

Burning Not Recommended As Control Measure

Experiments conducted during the winter of 1946-47 by Smith, tended to disprove the common belief that burning grass and debris will control insects.

Some investigators had encouraged the use of burning as a control measure, reporting that 50 to 70 per cent of the insects could be killed this way. Smith used the burning technique in an attempt to control plum curculio. The following spring he found that curculio had entered the orchards in sufficient numbers to cause considerable damage.

There were so many curculios left after burning that spraying and other control measures had to



Cryolite injury on small peaches that received a delayed petal fall spray.

be taken as often in orchards where debris had been burned as where it had not been burned. Fire does not destroy enough insects to be of any value, but it does destroy such things as food and shelter for wild life as well as organic matter badly needed in the soil.

Price Information, Packaging Seen as Main Peach Marketing Problems

About 80 per cent of the peaches produced in the Sandhills of North Carolina enter commercial channels. Growers sell approximately one-third of all peaches to buyers on a tree-run basis; one-fourth are packed, graded and sold direct to wholesale buyers; and about two-thirds are sold to terminal market commission men on a whole-sale basis.

These were among the preliminary findings of M. A. Abrahamsen and George Capel who made a study of marketing practices followed by peach growers during 1947. The study gave attention to sales methods as related to size of orchard, variety and transportation practices.

There was considerable variation in the sales patterns for the four main varieties—Elberta, Hiley, Georgia Belle, and Golden Jubilee. Time of picking, production in other regions and competition from other fruits and vegetables showed a marked influence on prices received for these varieties. About 70 per cent of all peaches left the Sandhills by truck, and 30 per cent by rail.

The study indicated that growers need more information on production, prices and general economic conditions.



Grading and packing is an important operation in placing quality peaches on the market.

Leaf Spot Fungus Spreads to Fruit, Causes Moldy Core

An apple disease condition in which fruit became moldy at the core and black rot fungus extended into the flesh was found prevalent in several orchards during 1947 by C. N. Clayton and Robert Aycock.

In some orchards as much as a third of the crop was affected by the disease. In addition the disease continued to develop in some apples after harvest. In almost every case, isolations from the rot yielded the black rot fungus, *Physalospora obtusa*, which also causes a leaf spot of apple.

Just why the rot and moldy core were so prevalent during the 1947 season is not fully understood. The moldy core condition is quite common most years, especially on the Delicious variety. But it is usually not very noticeable unless some fungus like black rot is involved.

The black rot organism produces spores readily on the dead bark of twigs. It is particularly abundant on apple twigs that have been pruned off or killed by fire blight. Spores capable of in-

fecting fruits are also produced on frog-eye leaf spots.

No control for moldy core is known. Black rot can be reduced by burning all dead twigs and prunings and by the control of frog-eye leaf spot. For several years Fermate, used in spray tests, has given effective control of this latter disease.

Fermate, Phygon Cut Down Spray Injury

Spray injury often cuts down the market value, appearance and quality of Golden Delicious apples. During the 1947 season, C. N. Clayton and Robert Aycock conducted tests in Wilkes County to determine the effect of several new spray programs upon fruit appearance.

Fruit sprayed through the season with Fermate or Phygon had a very good "finish" with a minimum of russet. Those sprayed with the regular lime-sulfur-Bordeaux mixture were severely russeted and of low market value.



Magnesium For Grape Chlorosis

TESTS IN 1946 showed that the onset of a common chlorosis of muscadine grapes was delayed somewhat by spraying the leaves with magnesium sulfate solutions. In 1947, therefore, W. L. Lott carried out further tests with magnesian

sulfate applied to the soil and injected as solutions into the stalks of vines.

No beneficial effects were obtained from soil treatments, but the injections prevented the chlorosis. The effect was obtained in both James and Scuppernong varieties if as much as 50 grams of magnesium sulfate per vine was injected.

It is not surprising that the vines failed to respond to soil treatments with magnesium sulfate. Similar tests made elsewhere with apple and tung trees have shown that responses usually occur only after two or three years of repeated application. The tests with grape vines will be repeated and the vines will be kept under observation during subsequent seasons. The work is also

being extended to determine whether grape yields can be increased by supplying magnesium in the fertilizer or in dolomitic liming materials.

Late summer chlorosis of muscadine grape leaves (left and center) was probably caused by a magnesium deficiency. Compare them with the normal green leaf (right).



Mulching of Red Raspberries Promotes Growth, But Encourages Diseases

Mulching of red raspberries produces a larger plant, but C. F. Williams and V. H. Underwood find that yields are not increased unless diseases are controlled.

The two workers conducted tests of several different mulch materials with Latham Red Raspberry, beginning in 1943. Grain straw, legume hay, pine straw, sawdust and strawy manure were used in comparison with clean cultivation. All these mulches increased plant growth, as measured in number of canes per hill and average length per

cane. However, in spite of several sprayings each year, foliage and cane diseases have been so severe that canes died back before fruiting and yields have not been satisfactory.

Mulches of legume hay and strawy manure produced the best cane growth. Grain straw ranked second and pine straw and sawdust last. Mulching lowered soil temperatures and improved soil moisture conditions and soil texture. The advantages gained by mulching were off-set by loss of canes from diseases.

New Dewberry Seedling Out-Yields Standard Variety

A dewberry seedling, developed in the breeding program and known as 38-7-3, produced much higher yields in a four-year test than Lucretia, the standard commercial variety.

C. F. Williams reports that the fruit of this selection is large, requiring only 180 berries to fill a quart cup in comparison to 210 for Lucretia. The fruit is also sweeter, firmer, of better quality

and ripens about three or four days earlier than Lucretia.

Similar results with this selection have been obtained in plot tests at the Coastal Plain Station and in the Sandhills. Some of this superior performance is due to its greater resistance to leaf and cane diseases. This selection is being propagated for introduction in 1948-49.

Copper Deficiency Of Strawberries Shows Up In Discolored Leaves

Controlled greenhouse studies have shown that the strawberry, like many other crops, requires



A deficiency of copper in the strawberry plant causes red areas between the veins of young leaves (center) and yellowing between the veins of older leaves (right). Compare them with the uniform green of the normal leaf (left).

small amounts of copper for normal growth.

W. L. Lott found that when plants of the Massey variety were grown with their roots in highly purified nutrient solutions, they made excellent growth if all the known essential elements were supplied. When copper was withheld, growth was retarded and leaves exhibited abnormal colors.

Young leaves were pale green with areas of red between the larger veins. Leaves of intermediate age were pale green to yellow with the veins remaining green, to give a pattern like that for manganese deficiency. With increasing age, the symptoms of copper deficiency in leaves became less distinct. Copper deficient plants had pronounced red colors in all the stems and petioles, as contrasted with the absence of this color in manganese deficient plants.

Missionary Variety Leads In Strawberry Yield Tests At Willard

In the 1947 strawberry variety tests, E. B. Morrow tried out 12 named varieties and four selected hybrids at the Willard Station, 16 named varieties at McCullers and 25 at Waynesville.

Missionary produced the highest yields at Willard though its berries were smallest of any variety in the test. The yields of Bellmar, Midland, Konvoy, Suwanne, Southland, NC 1042, NC 1039 and Temple were equal to those of Blakemore and Massey. Those of NC 1012, Maytime, Fairmore and Premier were smaller. Those of Massey were the largest. The earliest varieties were NC 1012, Blakemore and Maytime, in the order named.

Sixty-seven hybrid selections were also tested at Willard. Eight of these outyielded Blakemore and five outyielded Massey. Fifty-four selections produced berries larger than Blakemore and 11 produced berries larger than Massey.

Temple and Tennessee Supreme produced better

than Blakemore in the McCullers tests. Tennessee Supreme also outyielded Massey, but the berries were too soft, except for processing. Southland, Maytime, Midland, Bellmar, Fairpeake and Redstar were equal to Massey in total yield. Ten of the 16 produced berries larger than Blakemore, but none were larger than Massey.

In a test comparing 22 selected hybrids with Blakemore and Massey, NC 1233 and NC 1256 produced better than Blakemore or Massey. Four selections, NC 1048, NC 1053, NC 1235 and NC 1256, produced berries larger than Massey. No selection was smaller than Blakemore, and six selections were as early.

In the Waynesville tests, 12 of the 25 varieties tested yielded heavier than Premier, long the standard variety in that section. Nine varieties yielded as well as Blakemore, but none yielded better. Klomore and Southland were the earliest-ripening varieties. Redstar and Chesapeake were the latest.

Find Ideal Potato Spacing



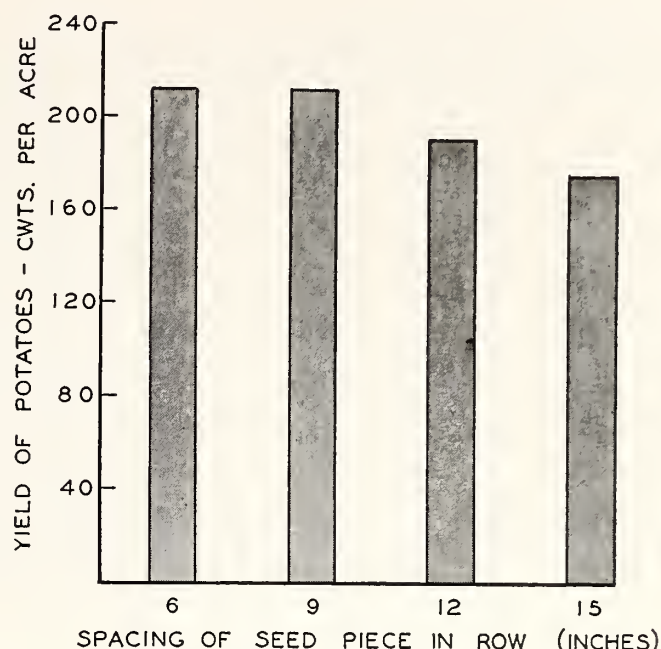
NINE INCHES proved to be the optimum distance for the spacing of Irish potato plants in the row in experiments conducted at two locations by W. L. Nelson, C. D. Welch and W. S. Moore. Experiments at one

location were conducted under irrigated conditions, while relatively dry conditions prevailed at the other.

While more seed is necessary at the closer spacings, the increased yield obtained more than offsets the increased cost of planting seed. With a spacing of nine inches, an increase in yield of 21 bags per acre was obtained over the 12-inch spacing.

The amount of nitrogen contained in an application of 2,000 pounds of 6-8-10 per acre is adequate for Irish potatoes. Nelson, Welch and Moore reached this conclusion after averaging the results from seven experiments in which the nitrogen requirements of Irish potatoes were studied.

The experiments were conducted on soils normally used for commercial potato production in eastern North Carolina. There was no increase in yield for fertilizers containing higher amounts of nitrogen.



Plant the seed pieces close together for high yields of Irish potatoes.

Early Defoliation of Potatoes Does Not Effect Quality

The premature defoliation of potato vines in experiments at Camden had no significant effect upon the quality and grade of Irish potatoes after digging. In these studies F. D. Cochran used as qualitative factors the amount of "feathering" or skinning, size, total solids and reducing sugars.

Seed of the Irish Cobbler variety was planted March 1, the defoliants applied June 19, and the tubers harvested June 25. A tractor-drawn butane flame thrower, several chemicals applied as spray, and one applied in dust form were used to kill the

plants. Readings were made on the degree and rapidity of kill the week following application.

Killing the vines prematurely causes a reduction in yield and total solids. Only slight stem and discolorations were found, but these may have been more pronounced if the potatoes had been stored.

It was interesting to note that the amount of "feathering" after digging was only 10 to 15 per cent. After digging and grading, the "feathering" ranged from 40 to 57 per cent. Obviously, the potato industry needs more efficient and modern grading equipment.

State Needs Irish Potato Resistant to Bacterial Wilt

By the end of the 1947 growing season, J. H. Jensen and F. D. Cochran had reduced the number of Irish potato seedlings in the bacterial wilt resistance tests to 186. Seventeen hundred seedlings were planted when the tests were begun in 1944.

The test plots are located on the McCotter farm at Cash Corner in a "cut" which is heavily infected with the wilt organism. The years 1945 and 1946 were unfavorable for the development of wilt due to unseasonably low temperature during the growing season. During those years, only the



Overhead sprinkling as a means of increasing Irish potato yields is becoming increasingly popular.

very susceptible lines were discarded.

Many of the surviving lines will be crossed and inbred in an effort to obtain a well-adapted high quality variety which is wilt resistant. Since wilt is not a problem in the mountains or the late potato belt, selections have been made from the original seventeen hundred for desirable characteristics and disease resistance, especially late blight.

Irish Cobbler, Sequoia Lead in Yield Tests

Irish Cobbler and Sequoia gave the highest yields in Irish potato variety tests for the coastal plain (at Camden) and the mountains (at Jef-

erson), respectively. Cochran conducted the tests under commercial conditions for a comparative study of dry matter content as well as yields.

Of the 41 varieties and selections planted, 19 were represented in both plantings. Irish Cobbler averaged 430 bushels per acre in the Camden plantings—a significantly higher yield than that of any other variety tested. The only two seedlings that had Irish Cobbler as one of the parents both yielded poorly. Marygold ranked second in yield with 290 bushels per acre.

In Jefferson planting, Sequoia yielded 549 bushels per acre. Pontiac was second with 422 bushels and Marygold fourth with 382 bushels.

Five States Cooperate In Drive To Cut Marketing Losses

A high rate of deterioration among early Irish potatoes between digging and their arrival on northern markets has led to the establishment of a regional marketing study with M. A. Abrahamson representing North Carolina. The study is being conducted jointly by the Agricultural Experiment Stations of Florida, Alabama, South Carolina, North Carolina and Virginia and by the Bureaus of Agricultural Economics and Plant Industry of the U. S. Department of Agriculture.

The study is designed:

- To determine factors causing or associated with spoilage in the marketing of early Irish potatoes.

- To investigate such economic aspects in marketing as adequacy of market information, operating practices and efficiency of market agencies, development of new marketing methods, analysis of competition and consumer preferences, and analysis of price making forces, with attention to differentials for grade and quality.

- To experiment with ways and means of reducing spoilage in marketing early Irish potatoes.

Sweet Potatoes Found To Be Rich Source Of Vitamins

Nancy Gold and Maryland Golden varieties of sweet potatoes had the highest ascorbic acid (vitamin C) and carotene (vitamin A) content at harvest time of ten varieties tested during the past three years. The tests are being conducted by W. J. Peterson, F. D. Cochran, Harriet Pressly and F. W. Sherwood.

In the ascorbic acid tests, Nancy Gold and Maryland Golden were the undisputed leaders, their content ranging from 28.7 to 38.3 mg. per 100 grams. For two years Little Stem, Jersey, Ranger and L-37 varieties were next highest. Their ascorbic acid range was from 25.2 to 30.6 mg. per 100 grams.

Nancy Gold, Ranger, L-37 and Maryland

Golden, the orange-meated varieties, were highest in carotene for the three years. The values ranged from 4.0 to 5.5 mg. per 100 grams.

In addition to the tests at harvest time, further tests were conducted after curing and after storage for four months. The average retention of vitamin C after curing for all varieties for the three years was 95 per cent; after storage for four months the average retention was 70 per cent. The average retention of carotene after four months was 98 per cent.

The workers conclude that even after four months of storage, the sweet potato is a good source of vitamin C and carotene. They found it unusual in its ability to undergo cooking with only small losses of vitamins.

Truck Crop Specialists Launch Sweet Potato Improvement Program

A sweet potato breeding program was initiated in 1947 under the leadership of F. D. Cochran and Daniel T. Pope. Primary objectives of the program are to develop varieties that are resistant to Fusarium wilt, black rot and internal cork.

It takes special treatment to force sweet potato plants to bloom in North Carolina. The plants are grown in the greenhouse by girdling and grafting techniques. They are forced to grow on a trellis, thus improving the light conditions for bud and

flower development. These methods have proved satisfactory with most of the varieties and seedlings.

Although most of the plants produced flowers, an extremely low percentage of fertility has been found. Preliminary investigations indicate that irregular chromosome behavior, giving rise to unbalanced and slowly-germinating gametes, is partly responsible for low fertility. Due to the polyploid nature of the plants, chromosome irregular-



Porto Rico (1), Queen Mary (2) and two white skinned seedlings, L-37 (3) and L-138 (4). The surface bruises and root scars are much more prominent on the white skinned varieties and may be a serious market objection. L-37 (3) has a tendency to produce irregular shaped roots, particularly round shapes.

ities do not cause a great amount of pollen abortion.

Porto Rico Variety Excels

The Porto Rico continued its performance as the most satisfactory sweet potato variety for North Carolina in 1947 tests by Daniel T. Pope at the McCullers Station.

Altogether, eight varieties were grown in these tests: Porto Rico, Nancy Gold, Maryland Golden, B-2934, Ranger, L-37, Queen Mary, and L-138. Each was fertilized at the rate of 1,000 pounds of 3-9-9 per acre plus five pounds of borax.

The vines were removed on October 21, and all plots were harvested October 23. Curing was done in several days at 85 degrees and with 85 per cent relative humidity. The shrinkage in curing varied between 3 and 8 per cent.

The seedling, L-37, included in the test because of its resistance to *Fusarium* wilt, produced high yields, but had a low percentage of U. S. No. 1's. It does not measure up to Porto Rico in appearance and marketability. Nancy Gold and Queen Mary are acceptable to the trade, but are very susceptible to wilt. L-138, Ranger and B-2934 are not acceptable due to roughness and white skin color.

Internal Cork Disease Found in 26 of 31 Leading Sweet Potato Counties

Results of a sweet potato plant bed survey by D. E. Ellis in June and July 1947 showed that internal cork disease is quite generally distributed in North Carolina. The disease was found in 26 of the 31 leading sweet potato producing counties

included in the survey. In many areas, however, the disease is at a comparatively low level of severity.

In the survey 176 samples, averaging 44 potatoes per sample, were collected and examined. The disease was found in only 65 (37 per cent) of the samples, and of these, 33 (50 per cent) were classified as having only "slight" cork, 28 (43 per cent) as "moderate" and only 5 (7 per cent) as "severe."

Internal cork is a new and potentially dangerous virus disease which was first discovered in South Carolina in 1944. It has since been found in most of the southeastern states. It causes dark brown cork-like spots scattered throughout the flesh of the potato. These usually cannot be detected until the potato is cut open. If the spots are numerous enough the potato is not edible.

On the leaves, the virus causes a characteristic purple ring-spot. Since this symptom has been observed throughout the sweet potato-producing areas of the State, the disease is probably more widely distributed than the survey indicated. This fact, together with the probability that the disease is insect borne, would seem to make it almost impossible to eliminate it from present seed stock.

Every effort should be made however, to keep it at its present low level. Until more is learned about the disease the following suggestions are made: 1. Stocks which are free of the disease should be used for seed purposes, if they are desirable in other respects. 2. Stocks known to contain the disease should not be used for seed.



Internal cork of sweet potato. The dark, cork-like spots are scattered throughout the flesh of the potato. Usually they cannot be detected until the potato is cut open.

Sweet Potato Vine-Row Harvester Placed With Manufacturer

The sweet potato vine-row harvester, as developed by G. W. Giles for moving vines out of the way before digging, has now been placed in the hands of a manufacturer. A few of the new machines have been built, several of which were placed in the important sweet potato-growing states for study in 1947.

The first machine developed was built to be pulled by horses or tractor. A better attachment, which mounts the harvester on the drawbar, has now been made for use on the one-row tractor. The machine can be made to harvest rows of different heights with an up-or-down adjustment of the hydraulic lift on the tractor. It is easily lifted off the ground for turning around without stopping the tractor.

The finger wheel developed for use on the "Vine-Row" harvester, is now being used for raking hay and weeding cotton. G. W. Giles used it first for windrowing hay when it was a part of the vine harvester. Field trials of a complete rake, using the finger wheels, have shown that it might be used successfully in a side delivery rake of low cost.

The new rake is built to handle two five-foot swaths. Its position on the tractor is such that the rear wheels do not pass over the hay. It is easily operated in odd-shaped fields. The raking action is always in easy view. Each finger wheel is always on the ground, turning free of the others. This makes clean raking possible over terraces and uneven land.

Consumers Show Preference For Medium-Sized, Brushed Potatoes

The study of consumer preferences for various grades of sweet potatoes was expanded by M. A. Abrahamsen to include methods of preparation for sale (brushed, washed, and waxed) and size (small, medium, and large.)

When the price was the same (10 cents a pound), all consumers interviewed said that they preferred either washed or waxed sweet potatoes to those that were brushed. Prices, however, influenced preferences. When prices were 8 cents a pound for washed, 10 cents for brushed, and 12 cents for waxed yams, 49 per cent of the consumers selected sweet potatoes that were brushed. Thirty-four per cent chose washed, and 17 per cent indicated a preference for those that were waxed.

Size also is a factor affecting preferences. At the same price schedule (10 cents a pound) 59 per cent preferred medium sized sweet potatoes (7-14 ounce), 23 per cent preferred large ones (15-24 ounce), 13 per cent preferred small yams (3-6 ounce), and 5 per cent preferred mixed sizes. However, when the prices were changed to 8 cents a pound for small, 10 cents for large, and 12 cents for medium, the percentage of consumers selecting these size classifications were respectively, 35, 36, and 25.

To producers, these findings suggest that the quality and method of preparation for sweet potatoes influence greatly the demand. Producers stand to benefit if they develop production and market programs which will supply consumers with what they want and will pay for.

New Snapbean Strains Prove Superior to Tendergreen, Logan

Several of the numbered snapbean strains furnished by the Vegetable Breeding Laboratory, Charleston, South Carolina, were superior to both Tendergreen and Logan in variety tests at two North Carolina locations.

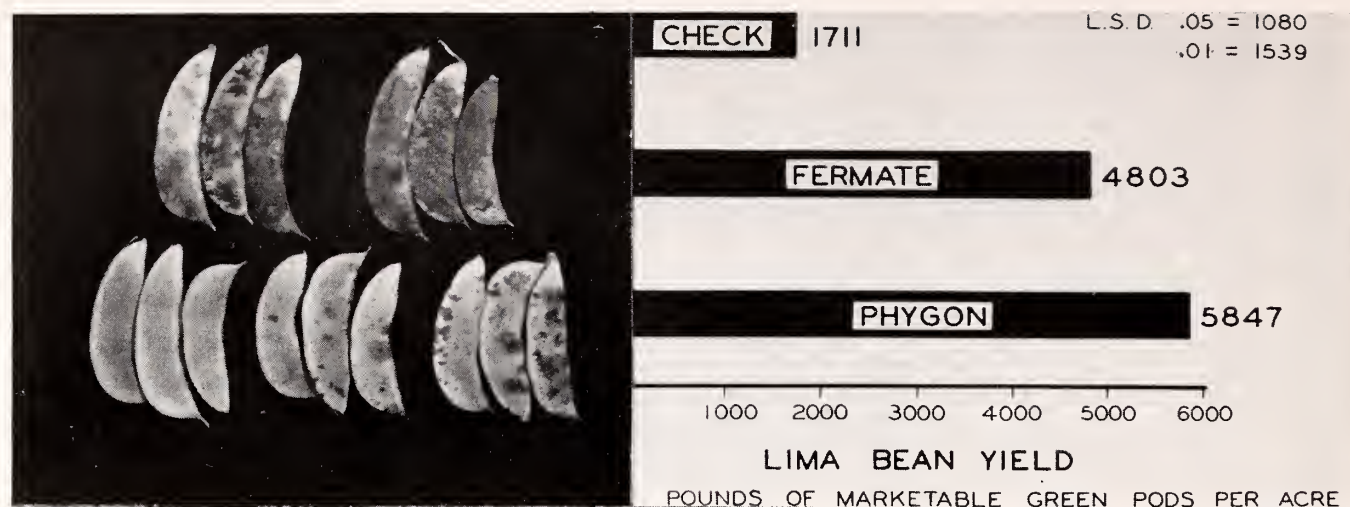
Sixteen varieties and strains were tested by F. D. Cochran at McCullers and twelve at Waynesville. At Waynesville, all were significantly higher in yield than Tendergreen, although the latter produced 450 bushels per acre in five pickings. The top yielding strain, B1661-9, produced 656 bushels per acre. Logan was sixth with 555 bushels. All of the varieties and strains at Waynesville were Tendergreen type. Many carried resistance to one or more diseases.

Yields at the McCullers Station were lower but

followed approximately the same trend. B1661-9 gave the highest yield with 267 bushels per acre and Logan was fourth with 253 bushels. Black Valentine was eleventh with 208 bushels. and Tendergreen was again the lowest with 142 bushels per acre.

In tests of 14 snapbean varieties at Wilmington, by J. M. Jenkins, Jr., Logan yielded heaviest with an average of 300 bushels per acre. Shipping tests have not yet been made for this new variety, developed by the Charleston laboratory. However, indications are that it will be satisfactory for commercial production.

Seed of Logan is available for 1948 plantings, but several of the strains that yielded high in the McCullers and Waynesville tests will not be available for two or three years.



Lima bean anthracnose causes numerous brick-red splotches on the pods (left). Pods in the lower, left hand corner are healthy; the others show different degrees of infection. The disease can be controlled as shown by the per acre yield increases (right), resulting from Fermate and Phygon sprays.

Phygon, Fermate Prove Effective Against Lima Bean Anthracnose

Phygon and Fermate gave excellent control of lima bean stem anthracnose in experiments by D. E. Ellis and R. S. Cox at McCullers Branch Station. The effectiveness of these materials when applied at weekly intervals as sprays is indicated in the accompanying graph.

As dusts, Phygon and Dithane Z-78 gave better control than Fermate, Zerlate or tribasic copper sulphate. Since some of the fungicides caused injury to the foliage, further testing is necessary before recommendations can be made.

Lima bean stem anthracnose is caused by a fungus (*Collectotrichum truncatum*) which dif-

fers from that causing common bean anthracnose on snapbeans. It produces numerous brick-red splotches on the leaves, stems and pods and may materially reduce yield and quality. It is especially serious during late summer and fall in home gardens and commercial lima bean plantings.

Greenhouse inoculation studies showed that the fungus may attack many related legumes, such as peas, beans, alfalfa and cowpeas, in addition to lima beans. Of the 16 lima bean varieties tested for resistance, only Jackson Wonder showed any tolerance. Even this variety was quite susceptible under conditions favorable to the disease.

Peerless, U. S. 343 Show All-Around Promise in Lima Bean Tests

Peerless and U. S. 343 appeared to possess the best combination of high yields and good quality of the eight varieties of small-seeded lima beans tested during 1947. The tests were conducted by F. D. Cochran and P. H. Massey at the McCullers and Waynesville Branch Stations. All small-seeded types were furnished by the Bureau of Plant Industry as a part of the National Lima Bean Testing program.

In both locations, the Illinois No. F₄ was highest in yield. But this variety was poor in color, especially when processed. In contrast, Peerless and U. S. 343, which were among the highest yielding varieties, both possessed a bright green seed color before and after processing. Md. 5643 was low in yield and undesirable in color.

Observation plots of Early Market and U. S. 242 indicate that these two large seeded varieties are high yielding and well-adapted to processing.

Workers Seek Tomato Resistant to Southern Bacterial Wilt

The breeding of tomatoes for resistance to southern bacterial wilt is being expanded by F. D. Cochran and D. E. Ellis. Several lines of the fourth generation crosses and selections are promising, but none are breeding true for disease resistance.

During 1947 efforts were made to stabilize the resistance factors and to increase the size and quality of the fruits. New techniques for handling and inoculating in the seedling stage are very promising and should greatly increase the efficiency in evaluating resistance. Crossing, selecting

and inoculating are now being done in the greenhouses during the winter months to hasten the development of a resistant variety.

Another phase of the tomato breeding program gives consideration to Fusarium wilt, and certain foliage diseases, particularly late blight. Approximately 150 varieties and strains were tested during 1947 at the Transou and Waynesville Experiment Stations for resistance to late blight. There were no immune types in the group, but a number of highly resistant types were found. Late blight resistance is particularly valuable for western North Carolina.

Tri-Basic Copper Sulfate Protects Cucumbers Against Downy Mildew



Tests in 1946 and 1947 by D. E. Ellis and R. S. Cox showed that a tribasic copper sulphate dust containing 5 per cent metallic copper is one of the best materials for controlling cucumber downy mildew.

How frequently should this fungicide be applied? Results of a test at the McCullers Branch Station in 1947 indicated that rather frequent applications are essential, particularly if the season is wet.

In this test the National Pickling variety was planted in 5-foot rows and spaced about 12 inches in the row in Norfolk sandy loam soil. The vines were trained along the row to facilitate dusting. The dust was applied in the early morning with rotary hand dusters.

Per acre yields (bushels) on plots dusted at the stated intervals were as follows:

- (1) Dust applied twice per week (eleven applications), 511;
- (2) Dust applied once every 10 days *and* after rains (ten applications), 524;
- (3) Dust applied once per week (five applications), 443;
- (4) Dust applied once every 10 days (four applications), 434; and
- (5) Non-dusted check, 359.

On the basis of this test it is recommended that cucumbers be dusted for downy mildew control not less than once every 10 days, and, in addition, after every rain sufficient to wash off the dust ($\frac{1}{4}$ inch or more).

Frequent dusting controls cucumber downy mildew. The plots above received 10 applications—yielded 524 bushels per acre. The plots below received no treatment—yielded 359 bushels per acre.



Washing Removes Cryolite Residue—Makes Vegetables Safe For Eating

Cryolite dust has been shown to be a satisfactory insecticide for the control of the pickleworm, a very destructive pest of cucumbers, squash and cantaloupes. Since cryolite is a poison, it is not desirable to have heavy deposits of this material on crops such as summer squash and cucumbers which are consumed without peeling.

In studies of cryolite residues, B. B. Fulton, R. C.

White, and Ivan D. Jones found that by washing the cucumber or squash with water, the residue may be reduced to a non-dangerous level. They also found that where the crops were picked just before dusting, there was not an excessive cryolite residue, except on small cucumbers.

If either of these precautions is taken, cryolite dust may be considered a safe control measure for pickleworm.

Soil Treatments Reduce Vegetable Root Knot

Soil treatments are definitely effective in reducing injury from root-knot, according to the results of further tests by C. N. Clayton and D. E. Ellis.

On soil heavily infested with the root-knot nematode, application of Uramon, D-D, or chloropicrin reduced the severity of root-knot to less than 5 per cent. This compared with a severity of 98 per cent on untreated plots.

The per acre yields of marketable tomatoes for treated and untreated plots averaged approximately 12 and 7 tons, respectively. Root-knot must be severe before treatment to secure such increases in yield. Clayton's and Ellis's findings furnished at least partial answers to other questions.

Will chemical soil treatments completely eradicate the root-knot nematode? NO. In two experiments at McCullers, six different nematocides were applied to plots treated with the same materials the previous year. While all again gave practical control, no treatment completely eliminated root-knot nematodes from the soil.

Do all crops respond equally well to soil treatment for root-knot control? NO. Different crops respond differently on treated soil. In comparison with the untreated check, okra and tomato yields

were significantly increased on plots treated with chloropicrin, D-D, ethylene chlorobromide, and ethylene dibromide. Tomato but not okra yields were increased on Uramon-treated plots. Both crops produced highest yields on chloropicrin-treated plots.

None of the above treatments, however, resulted in any significant increases in snapbean yields. Perhaps this was due in part to the fact that beans are a comparatively early-maturing crop, and thus escape serious root-knot injury. Snapbean yields were markedly reduced on plots treated with Uramon, D-D, or chloropicrin. This injury may have been due to the effect of the treatments on the nodule-forming bacteria in the soil.

When should soil treatments be applied? THIS DEPENDS ON MANY FACTORS. In plots treated with D-D, chloropicrin, or Uramon, 14, 11, and eight months before planting, the best root-knot control occurred in those treated eight months before. The poorest occurred in those treated 14 months before planting.

What is the most practical effective rate of D-D? TWO HUNDRED POUNDS PER ACRE IS NEAR THE LOWER LIMITS OF EFFECTIVENESS. D-D was applied at 200, 400, and 600 pounds per acre. The highest rate resulted in the highest degree of root-knot control.

Program For Broccoli Improvement Begun

An improvement program for broccoli has been initiated by F. D. Cochran because of the possibilities this crop offers in North Carolina.

Selections have been made in DeCicco, Early Green Sprouting, and Medium Green Sprouting. Selected plants of all three varieties were taken into the greenhouse so that the flowers could be hand pollinated, thus eliminating the chances of cross-pollination. Seed from several plants of each variety have been obtained, and further selections will be made.

Great Lakes Lettuce Excels Wilmington

Great Lakes was the most promising of the commercial lettuce varieties tested in the Wilmington area during 1947, by J. M. Jenkins, Jr. However, some of the North Carolina strains were superior to any of the commercial lots in their ability to make good heads. Several had little or no tipburn, under the conditions that prevailed.

Some of the best North Carolina selections were brought into the greenhouse and saved for seed. If these lots continue to show superiority, seed will be increased and released for general use.

Vegetable Laboratory Completed Near Wilmington

An office-laboratory building was completed in August 1947 at the Vegetable Research Laboratory six miles north of Wilmington on the Castle Hayne Road. A large bulb storage house, an implement shed, a four room cottage, two storage sheds and two water pumps were already on the tract. Four deep wells are so located that any part of the farm can be irrigated.

The new building provides two offices, two laboratory rooms and other facilities. The laboratory is now fairly well equipped, and a number of projects are either underway or will begin soon.

The new vegetable research laboratory at the Lower Coastal Plain Branch Station. It was completed in 1947.



Collards Contain As Much Vitamin C As Eggs

The collard, popular southern winter vegetable, compares with or surpasses in nutritive value such similarly-used vegetables as cabbage, turnip greens and spinach. In recent tests by Harriet Pressly, W. J. Peterson, F. D. Cochran, F. W. Sherwood and F. H. Smith, raw collards (Georgia and Louisiana Sweet varieties) were found to contain an average of 200 mg. of vitamin C per 100 grams. This is about four times as much vitamin C as that found in fresh orange juice.

Eggs which contain 3.5 mcg./gm. of riboflavin are one of the best known sources of this nutrient. Collards contain 3.9 mcg./gm. of riboflavin to rank along with eggs. On a dry weight basis, collards have one and three-quarter times as much calcium as milk. The carotene (pro-vitamin A) content of collards is from one to two times greater than that of butter and sweet potatoes.

Vitamin C is the vitamin most easily lost during the handling, storing, processing and cooking of vegetables. When collards were stored for 48

hours under grocery store conditions (stored at room temperature during the day and in cold storage at night) the loss of vitamin C was quite small.

When collards were stored in ice for three weeks, there was a small but steady loss of vitamin C in three varieties (Herring, Vates and Wonder). The average loss was at the rate of about 1.7 mg. per 100 grams per day.

Collards cooked in a pressure saucepan for five minutes retained an average of 66 per cent of their vitamin C. Seven per cent was dissolved in the cooking liquid, and 27 per cent lost. The average retention for collards boiled in a covered pan for half an hour was 21 per cent. Fifty-six per cent was dissolved in the cooking liquid, and 23 per cent lost.

When freshly-cooked collards were allowed to stand for 20 minutes at room temperature, there was no serious loss in ascorbic acid, regardless of variety or method of cooking.

Promising Carnation Selection Reported

Another promising carnation selection, with Rebel as one parent and King Cardinal as the other, has been developed, reports G. O. Randall. The new seedling has a sturdy stem, a rich red color and has shown no signs of calyx splitting. The plants are vigorous and seem to have disease tolerance.

New carnations are needed in the South. Many of the existing varieties were developed in the North and are not completely satisfactory for southern conditions. Rebel, a nice red selection, was named and released to southern growers in 1939.

Livestock and Poultry





Barley Extends Grazing Period

WHEN USED AS winter pasture, barley can satisfactorily extend the grazing period in eastern North Carolina to well over 10 months. This is one of the main findings in three years of wintering trials by C. Pierce, Jr., J. E. Foster, E.

U. Dillard, R. L. Lovvorn, and E. H. Hostetler at the Central Experiment Station.

In the first trial during the winter of 1944-45, 22 beef calves were carried from October 24 to April 10. They made an average daily gain of 1.48 pounds per head for the three months they were on pasture. Grazing was discontinued and the calves held on dry lot feed from December 11, 1944, to March 3, 1945, because of weather conditions.

While on dry lot feed, the calves were fed 10 pounds of lespedeza hay and two pounds of barley per head daily. They made an average daily gain of one-half pounds for this period.

The 1945-46 group of 13 calves wintered from November 27 to April 16 on barley pasture with the exception of 12 days. They made an average daily gain of 1.45 pounds per head. Twelve calves wintered in 1946-47, remaining on barley pasture the entire period from November 19 to May 6. They made an average daily gain per head of 1.64 pounds.

The average wintering period for the three years was 23 weeks. The calves were on barley pasture an average of about 72 per cent of this time. The average daily gain for the time on barley pasture was 1.53 pounds per head.

Previous data on wintering calves at this station on a daily ration of 10 lbs. of hay and two lbs. of barley indicated that an average daily gain of about one-half pound could be expected. Therefore, the workers estimate that during the past three years, barley pasture replaced 1,160 pounds of hay and 323 pounds of barley per head. At the same time it produced 119 pounds more beef per calf.

Test Value Of Phosphate Fertilizer On Hay Fed To Sheep

The effect of phosphate fertilization on the composition and nutritive value of forages for sheep was studied by G. Matrone, J. A. Weybrew, F. H. Smith, J. C. Pierce, E. U. Dillard and W. J. Peterson.

The tests were conducted with soybean hays grown on a Bladen type soil extremely low in phosphorus. Some of the land had been fertilized with phosphate, some had not. In none of the tests did the hay grown on fertilized land cause greater weight gains or greater digestibility than

did unfertilized hay. Neither were there any significant differences between the fertilized and unfertilized when soybean hay was used for roughage and raw soybeans for concentrate.

When cerelese replaced soybeans as the concentrate, lambs which received hay fertilized with phosphate gained an average of .282 pound daily per lamb. This compares with daily gains of .192 pound for lambs fed unfertilized hay.

Digestibility studies showed the fertilized hay as having slightly higher digestive qualities than unfertilized hay.

Late Cutting of Grass Hay Means Lower Cattle Gains

Six weeks delay in cutting grass hay after it reaches the early bloom stage may well lead to lower cattle gains. This has been brought out in tests conducted at the Upper Mountain Experiment Station, Laurel Springs, North Carolina, in 1946-47, by J. C. Pierce, Jr., R. L. Lovvorn, W. W. Woodhouse, and E. H. Hostetler.

Meadow hay was cut at two different stages of maturity, and the yield and feeding value determined. The early cutting was made the last of June when in early bloom. The late cutting was

made six weeks later when the hay was fully mature. The early cut area yielded only 75 per cent of the hay tonnage of the late cut area but afforded considerably more grazing from the aftermath.

Wintering studies to determine the feeding value of the two hays were conducted, using both dry Hereford cows and weaned calves. Thirty Hereford cows were divided into two groups of 15 each and fed 20 pounds of hay per head daily for the wintering period. Likewise, 24 weaned



Beef cattle grouped for feeding trials on early and late cut meadow hay at the Upper Mountain Station, Laurel Springs.

Hereford calves were divided into two groups of 12 each and fed eight pounds of hay and two pounds of a grain mixture per head daily.

Over an 84-day feeding period, dry cows wintered on early cut hay gained 15 pounds per head while cows on late cut hay lost an average of 10 pounds. Weaned calves fed the same length period, but receiving in addition two pounds of grain per

head daily, gained 22 pounds each on early cut hay as compared to an average gain of 12 pounds for those fed late cut hay.

From these trials we may conclude that although slightly more hay tonnage is produced from late cutting this is more than offset by a loss in feeding value. Furthermore, considerably more fall grazing is afforded by the early cutting.

Careful Grazing Does No Serious Damage In Piedmont Forests

Four years of investigation by C. M. Kaufman have shown that under careful management the forage and vines in Piedmont forest types can be grazed down without too much damage to pine or upland forest growths. Where hardwoods are desired, however, grazing can be very harmful.

A cross-section of forage types commonly found in Piedmont forests was represented in these studies. Yearling steers in a pasture stocked at four and one-half acres per head began to lose weight at the end of six to seven weeks of spring and early summer grazing. At the same time, steers in a pasture stocked at the rate of six acres per head were still gaining a pound or more per day.

An analyses of the forages taken by the cattle showed a crude protein content ranging from 9.50 to 14.50 per cent. The seasonal average was more than 11 per cent. Calcium content was from .65 to 1.02 per cent, and phosphorus, .24 to .38 per cent. These are well above the accepted requirements of 9.00 per cent crude protein, .25 per cent calcium and .21 per cent phosphorus for growing steers and cows nursing calves.

The four years of spring grazing had no effect on the composition of the plant cover. The only noticeable change, other than in the trees themselves, was that the area covered by honeysuckle increased during the period of the study.

The most noticeable result of having had cattle

in the woods was the effect of browsing on several tree species in sizes from one foot in height to one inch d.b.h.* There was considerable browsing on yellow poplar, black gum and ash. Some minor species such as dogwood, redbud, cherry, blue beech and mulberry also were more frequently browsed than the more common sweet gum, red maple and oaks.

Because of the crown density and the number of trees, short periods of spring grazing had no effect on the amount of pine reproduction. Nor was there any noticeable affect on the amount of hardwood reproduction.

In their travels to and from water and about the pastures, the steers had made paths along some of the fences and roads. But there was no erosion or serious damage to the vegetative cover as a result of this activity.

The use of the woods by cattle reduces the danger of damage by fire. A rather short period of use in the spring does not have the beneficial effect of season-long grazing in this regard. Even though the ground vegetation is thoroughly browsed down by the middle of June, the interval from then until frost is long enough to permit a heavy regrowth of grasses and herbs.

* Diameter breast high, or four and one-half feet above the ground.



Left, above: Cattle in the woods in late May.

Right, above: The same area in mid-October. The regrowth following spring grazing was so rapid that the danger of fall fire was not reduced by grazing.



Left: Cattle will browse hardwoods and, when forced to do so by hunger, will ride down trees more than one inch d.b.h. (Diameter at Breast Height).

Hereford cows on heavily grazed reeds at the close of the grazing season.



Heavy Grazing of Switch Cane Injures Forage Stand, Reduces Cattle Gains

Rate of grazing on switch cane (reeds) has a definite affect upon cattle gains as well as upon forage stand. This has been demonstrated in three trials (1945-46-47) carried out in the Wenona area near the Tidewater Experiment Station by E. U. Dillard, J. E. Foster, J. C. Pierce, Jr., W. O. Shepherd and E. H. Hostetler.

The investigators used two rates of grazing, moderate and heavy, that were based on previous reed grazing studies in this area. Six 15-acre pastures were used, giving three replications for each rate of grazing. The rate of stocking was 2.5 acres per cow and calf for the heavy grazing, and 3.7 acres per cow and calf for the moderate grazing.

In the heavily-grazed pastures, between 80 and 90 per cent of the total forage had been used by the end of the grazing season. This rate of grazing had seriously injured the forage stand. The moderately-grazed pastures still contained from 50 to 60 per cent of their total forage at the end of

the season, and they showed no apparent damage to the stand. The indications were that when more than 50 per cent of the total forage is grazed off, the stand is cut seriously.

Both cows and calves made greater gains in the heavily-grazed pastures in all three years. With a grazing season extending from about May 12 to November 25, the greatest difference in gains came in the last month or six weeks. The forage stand was usually injured before there was noticeable difference in cattle gains.

The average gain per animal each season was 114 pounds for the cows and 238 pounds for the calves in the moderately-grazed pastures. It was only 64 pounds for the cows and 205 pounds for the calves in the heavily-grazed plots.

Moderate to light grazing of reeds not only conserves the forage stand, but the cows are in better condition to start the wintering period. Also, the larger calves at weaning are more valuable as stocker or feeder cattle.

Brahman Cross Calves Gain Faster Than Herefords On Same Feed

Beef calves out of grade Hereford cows, but sired by bulls of different breeds, namely, Hereford, Brahman and Africander, were compared in two trials at the Central Experiment Station in 1945-46 and 1946-47. The tests were conducted by E. U. Dillard, J. C. Pierce, Jr., J. E. Foster, T. N. Blumer, H. A. Stewart and E. H. Hostetler.

The Brahman X Hereford calves ate less hay and grain per 100 pounds gain than did either of the other two groups in both trials. Similarly, the average daily gain per head was greater for the Brahman X Hereford calves.

There were no consistent differences between the grade Hereford calves and the Africander X Hereford calves in feed lot performance. However, the Hereford group graded higher both as feeder cattle and as slaughter cattle than did either crossbred group. They had better body conformation and carried slightly more finish at the end of the feeding period.

At the conclusion of the tests, the animals were slaughtered and the meat observed. The carcasses of the Hereford group graded slightly higher than those of the other two groups.

Crossbred Brahman cattle have attained their greatest popularity in the Southeast when slaughtered as calves. However, these recent trials indicate that they are efficient in the food lot, and produce good quality finished carcasses.



A representative steer of Brahman X Hereford breeding at the close of a finishing trial.

Hand-Fed Pigs Gain Faster Than Those Left With Sow

Baby pigs were raised successfully to normal weaning age on milk diets supplemented with minerals and cod-liver oil. These tests are part of an experimental project being conducted by J. A. Weybrew, H. A. Stewart, F. H. Smith and W. J. Peterson to determine the nutritional requirements of suckling pigs.

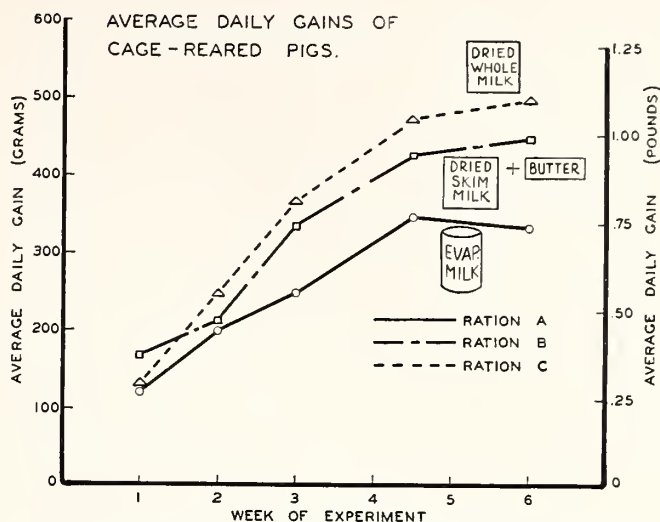
In this trial twenty-four pigs were placed in screen-floored cages at one day of age. Three essentially whole milk diets were compared. Diet A consisted of evaporated canned milk; Diet B, reconstituted skim milk solids plus butter; and Diet C, reconstituted whole milk powder.

While the pigs were very young, the milk diets were prepared so as to have a solids content of about 17 per cent. This is approximately the same as normal sows' milk. This concentration was progressively increased until the fifth week. After that the B and C diets contained 40 per cent solids. The pigs were given all the milk they would consume at four feedings daily.

At eight weeks, the average weights were 35.1, 46.8 and 48.6 pounds for the three diets, respectively. The apparent inferiority of the evaporated milk may be explained by the fact that pigs on this diet consumed much less. On the other two diets, pound-per-day gains were obtained by the seventh week (see figure). For the first three weeks, a pound of gain was realized for each pound of milk solids consumed.

At normal weaning age, all hand-fed pigs weighed, on an average, 9.6 pounds heavier than a comparable number of similar pigs that had been suckled by their dams on good pasture with access to a creep-feeder.

Pig losses, under the artificial-rearing scheme, are reduced through improved sanitation and through the elimination of suckling accidents. Mortality in this experiment was 12½ per cent. Birth-to-weaning mortality of over 30 per cent is usually estimated for suckled pigs.



Cage-reared pigs fed a ration containing dried whole milk gained weight faster than did pigs on similar rations, one containing dried skim milk plus butter and a second containing evaporated milk.

In other experiments to determine the nutritional requirements of suckling pigs, the blood of swine was found to contain almost two and a half times as much serum copper as does the blood of sheep, dairy cows and beef cattle.

Studies of various age groups of swine at the Central Station Farm gave an average value of 243 micrograms of copper per 100 ml. of serum. This compares with the working norm of 100 micrograms of copper per 100 ml. of serum that has been established for sheep, dairy cows and beef cattle in North Carolina.

The studies also suggest that sows at farrowing have a still higher blood serum copper content. Among the questions these data pose are: (1) Do swine have a higher copper requirement than other forms of livestock? (2) Is the present copper content of swine feeds enough for maximum efficiency of pork production? Some of these questions are being investigated.

Ultra-Violet Rays May Cause Some Rancidity in Frozen Meats

Ultra-violet lamps are used in meat chilling and aging rooms to control the growth microorganisms. There has been some evidence that the ultra-violet rays and the small amounts of ozone stimulant the breaking down of fats in the meat. A rancid taste and odor is the most common symptom of this breakdown.

Seeking more information on this problem, D. E. Brady, F. H. Smith, T. N. Blumer and Nelson Tucker have been conducting tests of pork and

beef to ascertain the effect of ultra-violet lights. Their testing methods have included measurements of free fatty acids in the meats and the determination of the "peroxide number."

In their experiments with pork, they found that back fat from pork carcasses stored at zero degrees up to 323 days after aging, showed no significant increase in the free fatty acid development due to length of aging period. The carcasses had been aged two, four, six and eight days at 36

to 38 degrees F. They did find, however, that as the length of the storage period increased, there was a small but definite increase in peroxide number.

Comparisons were made with back fat and leaf fat samples which has been aged two and six days with and without irradiation. The only differences which showed up were related to the length of aging period. Peroxide values were higher for leaf fat than back fat. The values were moderate at six months and relatively high at twelve months.

The beef experiments included a comparison of rib cuts aged seven and fourteen days with and without irradiation. After twelve months' storage at zero degrees, the cuts that had aged fourteen days had higher peroxide and free fatty acid values than those aged seven days. Beef aged seven days with irradiation had the lowest peroxides, while that aged fourteen days with irradiation had the highest. Other treatments were intermediate.

Rancidity and free fatty acid values were greater after twelve months storage than after six months. A palatability committee found that the juiciness and desirability of aroma of rib roasts were greater at six months than at twelve. Cooking drip losses were greater at twelve than six months. Cooking evaporation losses were greater on roasts aged fourteen days than those aged seven days. In general, all roasts were acceptable regardless of aging or storage treatment.

Suggest Ways To Avoid "Puffing"

A type of bone souring known as "puffing" has caused considerable loss in cured hams. This problem is acute where smokehouse temperatures are held for prolonged periods at 100° to 110° F.

Experiments conducted by Brady and his associates during the past two years show that this can be practically eliminated. One way is to allow the hams to hang for several months before smoking, thus reducing the moisture content and equalizing the salt distribution. Another method is to hold the smokehouse temperature below 100° F., and smoke the hams longer. A third, is to raise the temperature of the smokehouse to between 125° and 135° F. so that the internal temperature of the hams does not long remain in the danger zone of 65° to 105° F.

Dry Salt Sticks Reduce Curing Time

A method for the quick and uniform distribution of curing ingredients in hams and shoulders

would speed up curing and reduce spoilage losses. The "artery" pumping method and the "stitch" pumping method have filled these requirements except for the high moisture content which results. This is undesirable in strictly southern country type hams.

It is possible to inject dry salt sticks into hams or shoulders and to reduce the curing time from two to one day per pound of meat. This produces a ham or shoulder of desirable moisture and salt content with but one ounce of 95 per cent salt cover cure and one-eighth ounce of dry salt stick per pound of meat. The rather conspicuous openings into and within the ham or shoulder are the principal disadvantages of injecting dry salt sticks into the meat.

Foil Wraps Cut Down Freezer Burn

Initial experiments on controlling rancidity have shown that smoking doubles the rancid-free life of bacon.

Four treatments were made, namely heating to 112° F. as compared with 144° F., and smoking these samples six hours as compared with no smoking. Increasing the temperature and smoking markedly decreased the rate of peroxide formation.

The greatest benefits in smoking were noted when the temperature was high. Smoking as a single treatment was more effective than heating. The poorest results were encountered where neither heat nor smoke were used.

Smoking Extends Storage Period

The protection of frozen meats from freezer burn (meat drying) and rancidity depends primarily upon using high quality wrapping materials.

In a nine-months storage test, Brady and his associates wrapped identical cuts of meat in foil-laminated-to-kraft, cellophane-laminated-to-kraft, foil and glassine-laminated-to-kraft papers. The moisture losses of the four cuts by weight were .16 per cent, .27 per cent, .53 per cent, respectively.

Meats wrapped in impregnated waxed locker paper, one side waxed locker paper and kraft butcher paper had moisture losses of 5.25 per cent; 6.11 per cent and 13.07 per cent, respectively.



Market Demands Steady Flow

IN A STUDY of the marketing of fluid milk and milk products in North Carolina, Walter P. Cotton has found that Grade A milk production in the State falls 20 per cent short of bottled milk consumption. As a result a large volume of milk is im-

ported annually from as far away as New York, Pennsylvania, Minnesota and Wisconsin.

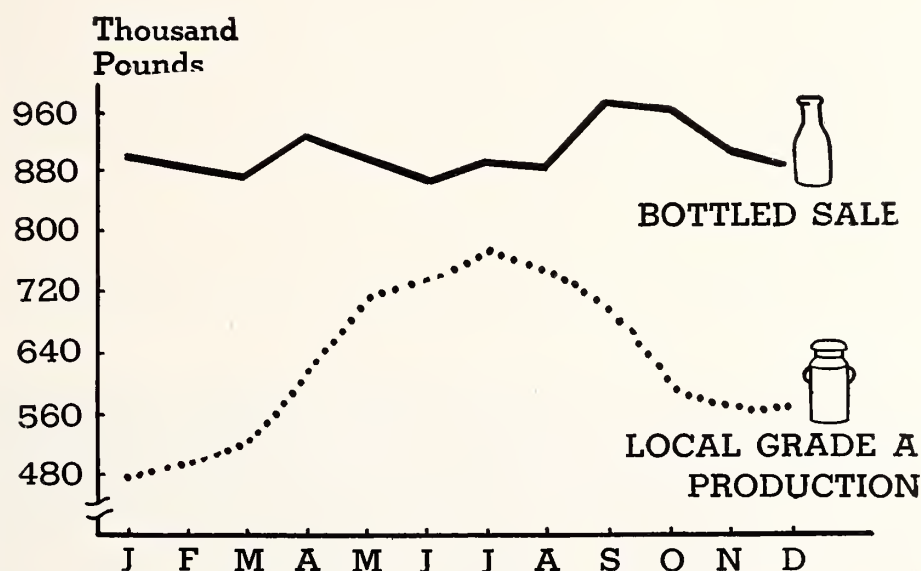
Local producers furnish processing plants with about 25 million pounds monthly during the summer. But in the winter, local production drops to around 15 million pounds. Sales of bottled milk at these same plants run around 25 million monthly for both summer and winter. Hence, milk imports vary from seven to eight million pounds in

the winter to about three million pounds in the summer.

The marketing survey showed that during the winter, every area in the State is short of Grade A milk. During the summer, some market areas have local Grade A supplies exceeding their local market requirements by some 2.5 million pounds monthly.

In the summer of 1947 much Grade A milk was bought for \$5.50 to \$5.80 per hundredweight and sold for \$3.00 to \$3.25 per hundredweight. During the same period, plants in deficit areas were importing around two and a half million pounds of fluid milk monthly from out of the State.

The North Carolina Milk Producers Federation, the North Carolina Dairy Products Association and the State Departments of Agriculture and Health are cooperating in the marketing survey.



North Carolina's youthful dairy industry is threatened by uneven seasonal production. Local grade A production reaches its peak at almost the same time that bottled sales reach their annual low.

Milk Production At Branch Station Goes Up 1,700 Pounds Per Cow

Since a dairy herd improvement program was started at Coastal Plain Branch Station, average milk production per cow for a 305-day year has increased 1,700 pounds. All records are on a twice-a-day milking basis.

Before the first proven sire was used at the Station, 22 cows in the Station herd averaged 8,096 pounds of milk and 411 pounds of fat. The 22 daughters of these cows by the first proven

sire had an average of 8,422 pounds of milk and 459.3 pounds of butter fat.

The second bull, bred onto the daughters of the first proven bull and foundation cows left 28 daughters that averaged 9,789 pounds of milk and 524.8 pounds of fat. The dams of these 28 cows averaged 8,497 pounds of milk and 457.8 pounds of fat. The third proven sire is now in service, but no daughters have come into milk.

Maturing Heifers Fail To Gain On Sorghum Silage Rations

Rations made up of sorghum silage, lespedeza hay and cottonseed meal proved unsatisfactory in heifer maturing studies conducted by C. D. Grinnells and J. L. Moore.

Heifers averaging one year of age were used in the tests. Group 1 was fed sorghum silage, five pounds of U. S. Grade 3 lespedeza hay, and one pound of 37 per cent cottonseed meal per day. Group 2 was fed sorghum silage and two pounds of cottonseed meal per day.

Both groups failed to make satisfactory growth. The hay group gained less than a pound a day, and the cottonseed meal group failed to gain, losing less than a pound a day. The results were less satisfactory than with similar trials where corn silage was used. The deficiencies, however, were largely made up during the first pasture season. All animals on the feeding trial were above the average for the breed.

Nutritionists Raise Healthy Calves On Synthetic Diets

A dairy farmer wouldn't think of trying to raise a good healthy calf without the aid of whole milk. But R. K. Waugh and R. N. Jarvis have succeeded in raising normal calves to the age of 12 weeks on strictly synthetic diets.

The synthetic diet used in these tests has been a mixture made up as a substitute for milk. Most of the time casein has been used as protein, dextrose or corn sugar for carbohydrate and hydrogenated cottonseed oil for fats. These ingredients are used in a highly purified form and weighed

separately before adding to the ration. Hence, the workers are able to change the individual amount of each ingredient at will.

One of the first comparisons run in these tests was between hydrogenated and non-hydrogenated cottonseed oil. The non-hydrogenated oil proved entirely unsatisfactory, causing diarrhea and death. The purified mixture or simulated milk containing hydrogenated cottonseed oil enabled calves to grow and remain apparently normal. However, growth has not been as rapid as for calves receiving whole milk.

These twin calves received the same feed, except the calf on the left received a diet containing 3.5 per cent non-hydrogenated cottonseed oil, while the one on the right received 3.5 per cent hydrogenated cottonseed oil.



Dehydrated Sweet Potatoes Almost As Good As Corn

Except for a low protein content, dehydrated sweet potato meal was nearly equal to corn in milk cow feeding trials conducted by R. K. Waugh, C. D. Grinnells and T. L. Moore.

In the one trial with five cows in each of two groups, dehydrated sweet potato meal was compared with corn made up of 40 per cent grain

mixtures, containing 18.5 per cent protein. The two mixtures were fed in a double reversal feeding trial with periods 30 days in length.

Slightly more milk was produced while the cows were receiving the ration with corn. However, the differences in amount of four per cent fat-corrected milk produced on the two mixtures were not statistically significant.

Overgrazing Encourages Spread Of Parasites To Healthy Animals

Overgrazing increases the parasite population in infected calves as well as encouraging the spread of parasites to healthy animals. C. D. Grinnells and J. L. Moore made this finding in a pasture study during May and June of 1947.

Twelve parasite-free calves were placed on parasitized plots—six on heavily-grazed plots and six on lightly-grazed plots. The heavily-grazed plots were one-half the size of the lightly-grazed plots.

The parasitic population, as indicated by egg counts, increased at a much faster rate in the calves on the heavily-grazed plots. Three of the six calves on these plots died suddenly, and two were destroyed because of weakness and inability to graze.

Dairy calves are often turned on pasture before their digestive equipment is large enough to process nutrients from grass for normal development. Undernourishment at this early age, coupled with a low resistance, partly due to age, accentuates the parasitic problem. The problem is further complicated when the pastures are overgrazed.

Heavy Fertilization Fails To Control Parasites

Attempts to cut down the parasite population of pastures with heavy applications of fertilizer have failed, according to Grinnells and Moore.

The plots used in this experiment were parasitized by the application of 10 tons per acre of calf fecal material. The calf had been excreting approximately 227,000,000 eggs per day.

The following amounts of fertilizer were used without effect: lime, one ton per acre; phosphate, 800 pounds per acre; muriate of potash, 100 pounds per acre; and nitrate of soda, 400 pounds per acre. Changing the source of nitrogen to uramon, a urea fertilizer, failed to show any variation in results.

Although there is a heavy mortality of the parasite in the eggs and larval stages, one infected animal can go a long way in parasitizing a pasture.

Strict Sanitation Measures Will Definitely Control Mastitis

Mastitis can be controlled with practical sanitary measures! This is the emphatic statement of C. D. Grinnells and J. L. Moore following tests during the past year for the incidence of the disease.

Tests were conducted every thirty days on some herds, every sixty days on others and every six months on two herds. The modified Hotis and direct microscopic tests were used. A count of 70,000,000 staphylococci with 500,000 leucocytes or a count of 100,000 streptococci agalactiae and 500,000 leucocytes per milliliter was considered an active infection.

Where sanitary practices were properly carried out, the infection was held down to less than 4 per cent of quarters tested. One herd showed 1.6 per cent of quarters infected, which is a low incidence of the disease.

Sanitary practices necessary for the control of mastitis are: (1) clean, dry stalls with plenty of good litter; (2) the application of good disinfectants such as lye solution or superphosphate to rear half of stall beds; (3) good udder hygiene—udders and teats wiped clean at each milking; (4) early treatment of teat injuries; and (5) partial segregation of active cases to one end of the milking line.

Scientists Seek Ways To Improve Quality Of Chocolate Milk

Roberts, Colvard and Stella May Efland made a preliminary study of the factors involved in making chocolate milk. They report the following observations:

1. An initial viscosity of 100 or above (as determined by the MacMichael viscosimeter, using a No. 34 gauge wire) is necessary to prevent sedimentation in chocolate milk. In this study the chocolate product was made from fresh milk and recombined milk (non fat dry milk solids and fresh cream, condensed skim milk and fresh cream and condensed whole milk.) The product must be cooled rapidly to 50 degrees F.

2. The Dutch process cocoas make a chocolate milk that is much darker in color than that made with American process cocoas.

3. The amount of stabilizer needed to prevent sedimentation depends upon (a) type and purity of stabilizer; (b) processing technique; and (c) milk ingredients used.

4. Viscosity increases with age up to 24 hours. However, sedimentation is governed by the initial viscosity.

5. As the viscosity increases, the intensity of the chocolate flavor and the sweetness decrease.

6. High fat cocoas give a smoother and milder flavor.

Now Possible To Freeze And Store Fresh Milk For Six Months

High quality milk, when concentrated to a 3:1 ratio and frozen statically at 15 degrees F., will keep satisfactorily for at least six months. This was the finding of C. D. Colvard and W. M. Roberts after conducting preliminary studies of the freezing method for preserving milk.

Since the protein in frozen concentrated milk tends to coagulate, the workers attempted to control this by adding sodium hexametaphosphate (Calgon) to the samples. The appearance of samples, some stored in waxed and others in

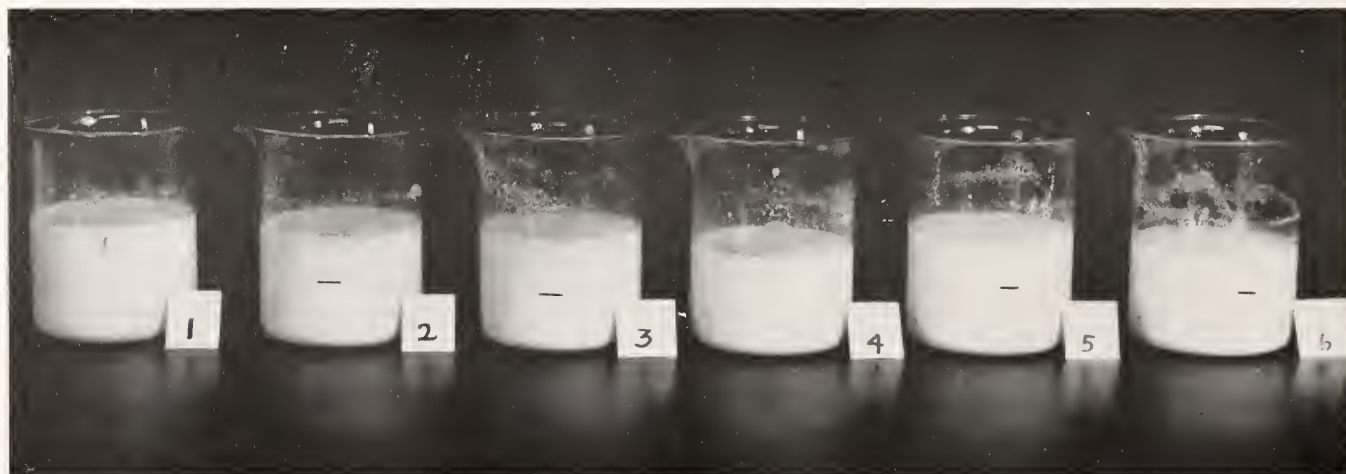
plain containers, is shown in the accompanying photo.

The protein stability index was as follows: sodium citrate treated and stored in plain cartons, 2.72 per cent; sodium hexametaphosphate treated and stored in plain cartons, 22.89 per cent; untreated and stored in plain cartons, 30.27 per cent; sodium hexametaphosphate in waxed cartons, 22.17 per cent; and untreated in waxed cartons, 32.79 per cent.

This indicates that sodium citrate may improve the stability of the proteins. In samples where the salts were added, the milk had a salty flavor.

Sodium citrate may turn out to be the long-sought chemical in stabilizing the protein in frozen milk. Samples 1 and 4 were treated with sodium citrate and stored in plain and waxed cartons, respectively. Samples 2 and 5 were treated

with sodium hexametaphosphate, and Samples 3 and 6 were untreated. "Tick" marks on the latter four containers indicate where proteins had coagulated and settled out.



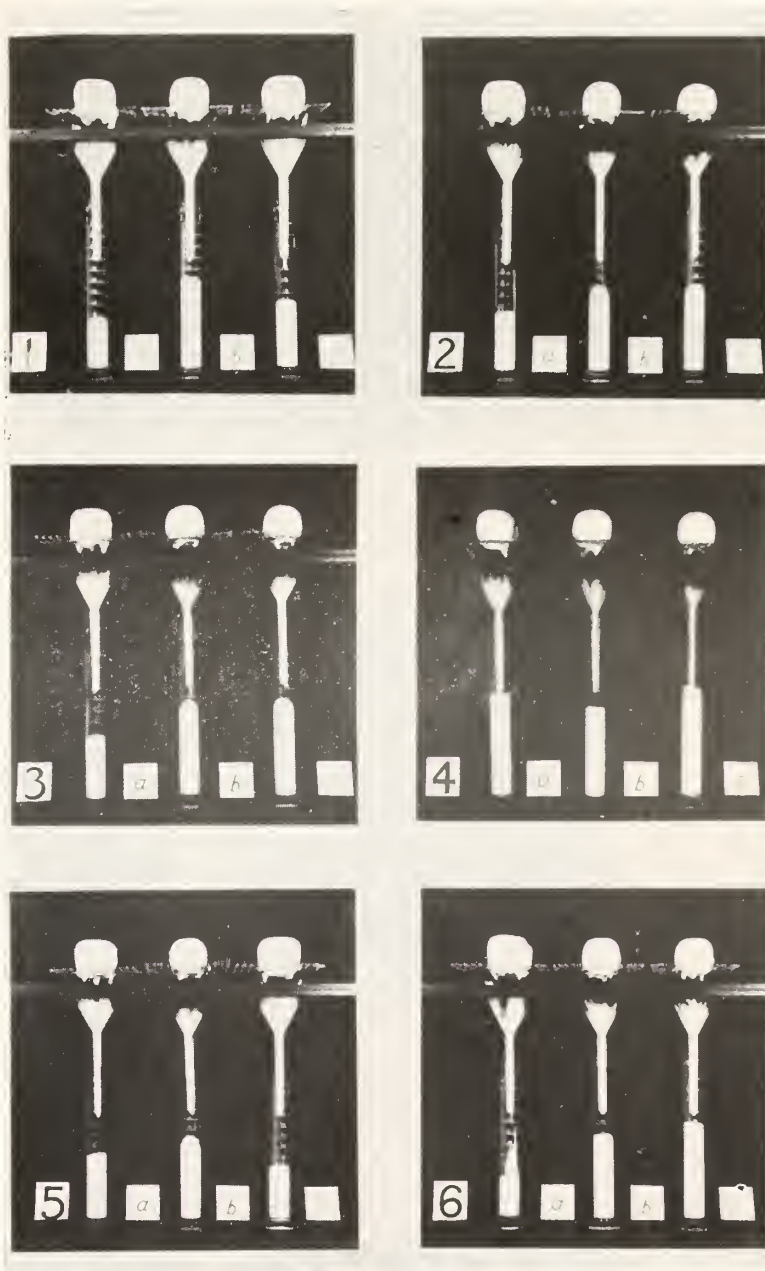
Milk Solids, Method of Freezing Effects Melting Rate of Ice Cream

Condensed skim milk proved to be the best source of milk solids-not-fat in ice cream mixes tested by W. S. Arbuckle and M. L. Shumaker. Condensed skim milk, sweetened condensed skim milk and non-fat dry milk solids were compared in these tests for desirable physical properties and flavor of the finished ice cream.

The rate of melting of ice cream is effected by the source of milk solids-not-fat. Ice cream containing non-fat dry milk solids melted most rapidly. Generally, the rate of melting was most rapid for ice cream frozen on the continuous freezers. Melting was slowest for ice cream frozen on the batch freezer, regardless of the source of milk solids-not-fat.

Ice cream containing sweetened condensed milk as the main source of milk solids-not-fat seemed more susceptible to shrinkage during storage, than ice cream containing condensed skim milk. In these tests the storage period was for four weeks at a temperature of six degrees above zero.

The melting rate of ice cream depends a lot on the source of milk solids and type of freezer. In these charts "a" indicates batch freezer; "b" and "c", continuous freezer. The source of fat and milk solids-not-fat in each case was (1) Cream, milk, condensed skim milk; (2) cream, milk non-fat dry milk solids; (3) butter, milk, condensed skim milk; (4) butter, milk, non-fat dry milk solids; (5) butter, milk, sweetened condensed skim milk, and (6) cream, milk, sweetened condensed skim milk.



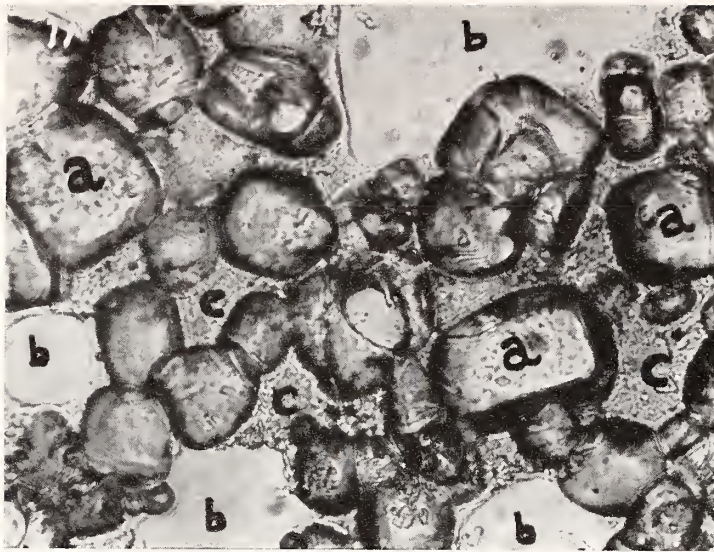
Microscope Reveals Inner Structure of Ice Cream

The microscope has proven a valuable aid to W. S. Arbuckle in his studies of certain texture characteristics of ice cream.

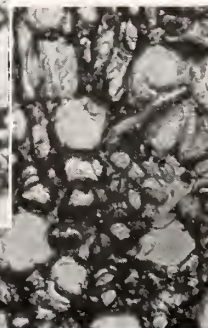
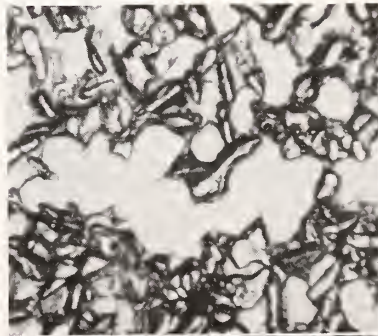
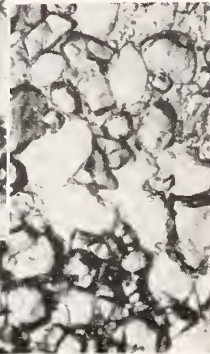
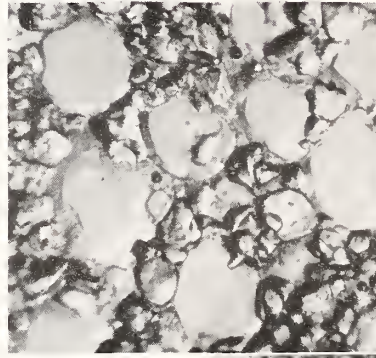
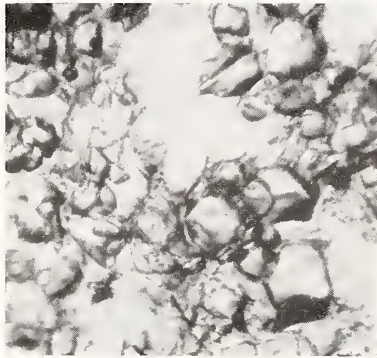
The accompanying photographs, show the internal structure of ice cream consisting of ice crystals and air cells surrounded by unfrozen

material. The finer texture of ice cream frozen on continuous freezers is demonstrated by the smaller ice crystals and the more uniform distribution of air cells.

Ice cream frozen without agitation or ice cream exposed to heat shock condition shows ice crystals much larger in size and more irregular in shape.



The internal structure of ice cream—ice crystals (a) and air cells (b), surrounded by unfrozen matrix (c).



Study Shows High Income Families Consume More Ice Cream

Recent studies in consumer preferences for ice cream, conducted by Robert E. Foye and M. A. Abrahamsen, show that income has a definite influence on the amount of ice cream bought.

According to these studies the relationship between monthly family income and purchases was as follows: Those earning less than \$200 per month reported weekly purchases of 2.6 pints in

summer and one pint in winter. When monthly family income ranged from \$200 to \$299, weekly purchases were 3.7 pints in summer and 1.5 pints in winter. Families having incomes of over \$300 purchased 5.1 pints in summer and 2.7 pints in winter. Hence, purchases among the high income families were about twice that of the low income families.

The structure of ice cream on batch freezer (left) and continuous freezers (center and right).

The structure of ice cream frozen without agitation (left) and heat shocked (center and right).



Progress In Turkey Breeding

YOUNG TURKEY HENS, 1946 products of the Station's sustained turkey improvement project, were found to be slightly superior in body conformation to those of the preceding year. The project is being conducted by C. H. Bostian,

R. S. Dearstyne and W. B. Nesbit.

Records were kept on the production and hatchability of eggs, broodiness and livability for 235 young hens grown during 1946 but kept for the 1947 breeding season. For the first 90 days of the egg-laying period, 77 per cent of the hens did not go broody. Livability was 95 per cent. Seventy-eight per cent laid at least 28 eggs during their first 56 days of production, qualifying them as R. O. P. During the breeding season, 64.2 per cent of all eggs set hatched into poults.

In another phase of the same project, 655 poults were selected in 1947 from the six single pen matings. At six months of age, each individual was weighed and measured for depth of body, length of shank, length of keel and width of breast. By the use of a special device, the breast was measured at a point exactly one-fifth of the distance from the underside of the body to the back.

In body conformation at six months of age, improvement was noted in some traits. Weight of toms and females was the same as in 1946, being 19 and 13 pounds, respectively. The length of shanks and depth of body were slightly less, with the length of keels and width of breast being greater.

For the 240 toms measured, the length of shank was 8.1 inches; length of keel, 8 inches; depth of

body, 9.2 inches; and the width of breast, 3.8 inches. Young hens had a breast width slightly greater.



Body conformation measurements are taken and given consideration when selecting turkeys for future breeding.

Laying Hens May Be Next On The List Of Hybrids

With the aim of producing hybrids with superior egg production, W. W. Glazener, R. S. Dearstyne and W. L. Blow are developing inbred lines of Rhode Island Reds, Barred Plymouth Rocks and S. C. White Leghorns at the College Poultry Plant. When the lines have been inbred sufficiently, they will be crossed between and within breeds to develop superior egg production and other desirable traits.

Such factors of egg production as sexual maturity, broodiness, persistency, intensity and freedom from pauses are under study. Egg size, shell color and quality are also considered in the selec-

tion of breeding birds. Hatchability and mortality are given prime consideration as these are often the limiting factors. At the present rate of progress, inbred lines should be available for crossing in three years.

The first six months' productions for the birds hatched in 1946 were 132 eggs for the Leghorns, 138 eggs for the Rocks and 140 eggs for the Reds. A slight drop in the number of days to sexual maturity was noted for the birds hatched in 1947 over those of the previous year.

This decrease averaged 19.9 days for the Leghorns, 10.0 days for the Rocks, and 8.1 days for

the Reds. All decreases in age to sexual maturity were accompanied by slight decreases in weight at sexual maturity. November egg weights during 1947 were slightly below those of the previous year.

It is encouraging to note that the superior inbred families performed as well as or better than the superior non-inbred families.

Hybrid Broilers Too

Glazener, Dearstyne and Blow are also developing inbred lines in three strains of Barred Plymouth Rocks and New Hampshires with the view of producing superior hybrid broilers.

Broiler quality is the main consideration, although egg production factors are also considered. Body size (12 weeks weights) has improved in all of the strains during each year of the experiment. Broilers raised during 1947 showed in-

creases of from 1 to 9 ounces per bird over the same strains for 1946.

Poor feathering has been practically eliminated in all but one of the six strains under study. Breast width and body depth measurements are made on all the progeny of pedigreed matings at 12 weeks in order to improve body conformation.

Age of sexual maturity has been improved until the average bird reaches maturity at approximately six months with little variation between strains. Broodiness during 1947 was lowered considerably from 1926 with four of the strains showing no broodiness during the first six months of production. The incidence of pauses of seven or more days during the first six months of production was reduced by as much as 60 per cent. All strains showed some improvement.

Hatchability decreased slightly, though some strains showed an increase.

Superior Egg-Producing Families On The Way At Coastal Plain Station

At the Coastal Plain Experiment Station, Willard, Glazener, Dearstyne and Blow are concentrating on the development of superior families for egg production. The poultry plant at the farm was considerably enlarged during 1947. More than 600 Rhode Island Red pullets were trapnested during the fall as a part of the project.

Days to sexual maturity were eight less in 1947 than in 1946. The downward trend in hen house mortality continued. The hatchability of all eggs set was over 80 per cent, an increase of more than 11 per cent over the previous year.

Total egg production, based on the first six

months after the bird starts laying, averaged 125 eggs per bird for 1947 as compared to 129 eggs per bird for 1946. The percentage of birds showing pauses of seven or more days during the first six months of lay was slightly higher in 1947. There was, however, a decrease in the amount of broodiness.

Two cockerals from a private breeder and two from the North Carolina State College flock were mated to Willard females during 1947. Complete results of these crosses will not be known until 1948. Superior pedigreed cockerels and baby chicks will be released to the farmers and poultrymen in the Willard area at that time.

Production Study Shows Way To Profit From Turkeys

Here are some of the questions that farmers ask when they consider turkeys as the main or a supplemental enterprise in the farm business:

- What is the cost per pound of producing turkeys?

- How much feed and labor does it take to produce a pound of meat?

- What is the gross and net income from turkey farms?

To answer these and other questions, R. E. L. Greene, W. H. Pierce and J. G. Sutherland studied the cost of producing turkeys during 1946 and 1947.

They found that the average gross cost per

bird raised in 1946 was \$6.62, or 34 cents per pound. The average price received was 36 cents per pound. The cost of poults averaged 81.5 cents per turkey raised.

Feed accounted for 73 per cent; labor, 6 per cent; and other costs, 21 per cent of the total cost. Man labor required averaged 120 hours per 100 turkeys raised.

Income from turkeys was 57 per cent of the total receipts on the farms studied. Average receipts per farm was \$8,712; expenses, \$6,676; and net farm income, \$2,026. Seventeen per cent of the farms studied made a minus labor income, while 35 per cent made a labor income of \$2,000 or more.

Miscellaneous



New Equipment Used In Study Of Soils

USING lime properly is one of the big problems of North Carolina farmers. In order to learn more about the correct use of lime on our soils, we must know more about how our soils are made up. North Carolina's soils differ greatly as we go from the coast to the mountains. One important difference is in the type of clay material in the soil.

To learn more about these clays, A. Mehlich and N. T. Coleman enlisted the aid of two new tools—X-ray equipment and the electron microscope. The equipment was made available through the courtesy of the Wisconsin Agricultural Experiment Station, and the studies were made in cooperation with that station.

Soil samples were collected by Mehlich and J. F. Reed from representative soil areas in North Carolina and the clay portions separated out. The results show that Bladen, Creedmoor and White Store soils contain primarily montmorillonite. Norfolk, Cecil, Durham and Georgeville contain primarily kaolinite. Alamance contains a mineral resembling beidellite, and Rabun and Fannin contain kaolinite and gibbsite.

These various named types of clay have a great influence on the absorption of phosphorus added in fertilizers. They determine the rate of reaction of liming materials, affect the calcium adsorption of plants, and, in turn, affect plant growth.

Soils that contain kaolinite and gibbsite absorb more phosphorus than those containing montmorillonite. This absorbed phosphorus is not very available to plants. The rate of reaction of liming materials, on the other hand, is faster with the soils containing montmorillonite than it is with those that contain kaolinite. Calcium held by soils of the montmorillonite type is not as available as that held by kaolinite type soils.

Hence, with the same amount of calcium, plants will grow better in the kaolinite type clay, such as in Cecil soils, than on the montmorillonite type of clay found in Creedmoor soils.

Laboratory tests with cotton and soybeans, growing in cylinders containing the two types of soils, demonstrated this fact. On the Cecil soil,

limestone produced very little response, but the plants responded readily on Creedmoor soil. On unlimed Creedmoor, soybeans made some growth, whereas cotton grew hardly at all. Hence, cotton may be said to have a higher calcium or lime requirement than soybeans.

The higher calcium requirement of cotton was verified by an analysis of the plants. When both crops were grown on a soil well supplied with calcium the plant analysis showed that cotton contained 3.2 per cent calcium but the soybeans only 2.2 per cent.



Plants growing on a Creedmoor soil, containing mostly the montmorillonite clay, (above) require a higher lime level than when grown on a Cecil soil, containing the kaolinite type of clay (below).

Four-Fifths Of Annual Soil Loss Occurs During Three Summer Months

More than 80 per cent of our yearly soil loss comes in the three summer months, June, July, and August, T. L. Copley found in recent tests. Less than 10 per cent of the annual loss occurs in the seven fall and winter months of September through March.

This seasonal pattern offers a key to the planning of soil conservation practices and other farm operations, says Copley. It emphasizes the need for protecting row crop land during the summer. Compared to this period, winter protection is of minor importance.

Consequently, contour tillage, strip cropping, terracing, and good rotation should be used as far as possible. Winter cover crops and other crop residues turned back to the soil also help. Erosion

being heaviest during the summer and lightest during the winter, permanent pastures and meadow strips usually should be seeded in the fall so as to become well established by the next summer.

Radioactive Materials Aid In Study Of Plant Fertilizer Needs

By adding very small amounts of radioactive phosphorus to the phosphorus in the fertilizer, it is possible to keep track of this element after it has been applied to the soil or has entered the plant. N. S. Hall and others are using this new procedure to study the phosphorus fertilization of corn, cotton, potatoes and tobacco.

Already new light has been thrown upon some of our fertilizer problems. For example it has been found that quite a large proportion of the phosphorus absorbed may come from the soil rather than the fertilizer. This proportion varies widely, as to the crop and the soil. If the soil test for phosphorus is high, a much higher proportion comes from the soil than if the phosphorus test is low.

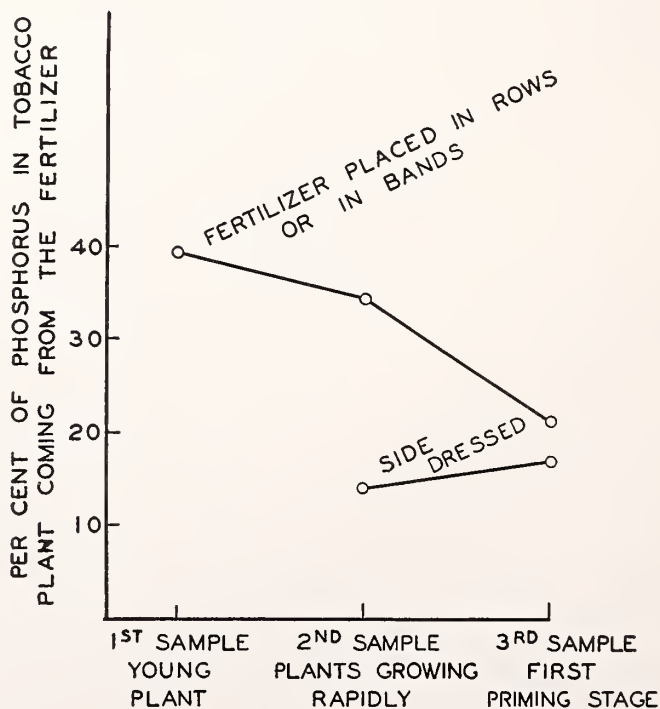
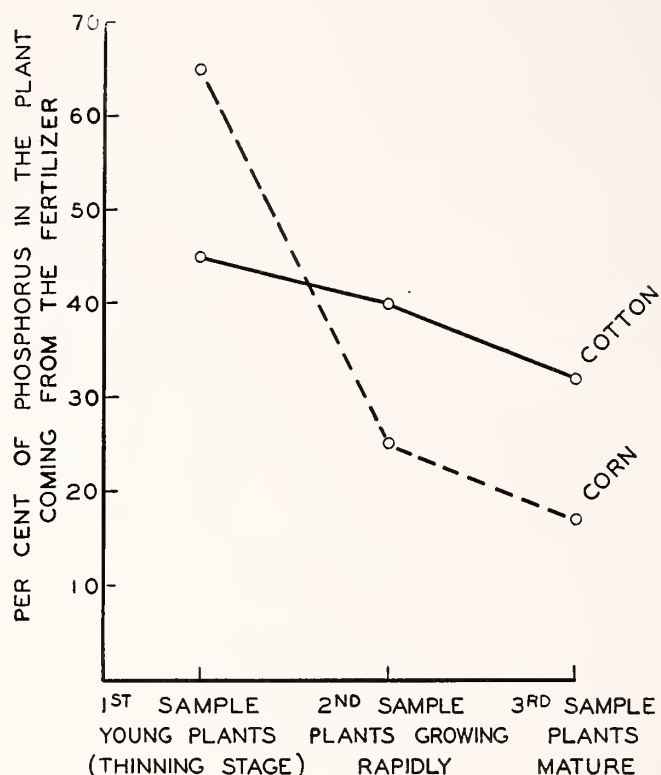
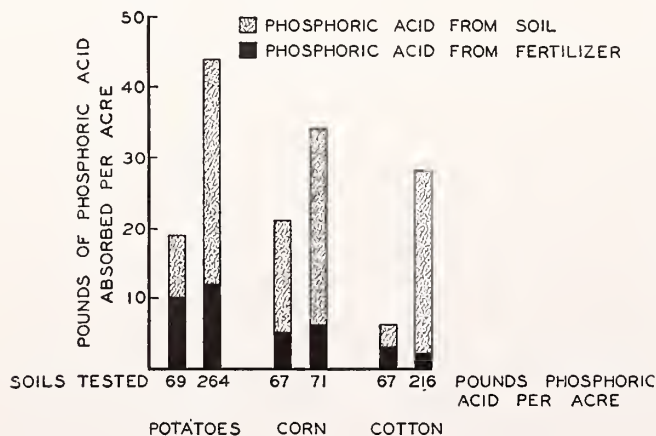
Another fact uncovered is that the proportion of phosphorus coming from the fertilizer may be quite high when the crop is young, but lower as it matures. This indicates that phosphorus fertilization may be much more important to a young plant than to an older one. Again this behavior varies considerably between different crops.

Other tests have shown that during the early period of growth when phosphorus needs are great, row placement is much superior to side placement. The distribution of the phosphorus in a tobacco plant is demonstrated in the cover illustration.

The utilization of applied phosphorus by crops at different stages of growth. (Upper right)

Placement of fertilizer effects the uptake of phosphorus by the plant at different stages of growth. (Lower right)

The amount of applied phosphorus utilized by three different crops. (Below)



Kudzu Valuable As Soil-Protector When Rotated With Corn On Eroded Land

For several years kudzu has been considered excellent for protecting badly eroded land and for furnishing supplementary grazing. In tests conducted by T. L. Copley it is demonstrating its value when used in a rotation with corn and small grain on land subject to severe erosion.

In 1945 a preliminary trial of corn following an established stand of kudzu appeared to justify further study. Questions to be answered were: (1) the amount of soil protection kudzu would give in a rotation; (2) how much feed would be produced; and (3) would kudzu survive and reestablish itself following one or more row crops and one or more small grain crops.

An over all three-year rotation was set up and subdivided into three different cropping systems. They are: (1) corn, oats and kudzu; (2) corn, oats, grain sorghum, and kudzu; (3) corn, oats, grain sorghum, oats and kudzu. Adequate fertilizer is being applied for each crop.

Results for the first two years of the experiment have been promising, particularly with the rotation of corn, oats and kudzu. Normal growth and good yields have been made with each crop. The kudzu has volunteered after the last cultivation of corn and also after the oats the next spring. From the conservation standpoint, it looks good since it affords soil protection during the summer when erosion is worst. Land preparation and tillage have not been difficult.

The kudzu runners, growing on the corn and in the small grain, may make normal harvesting difficult. However, it is an ideal combination for harvesting with livestock or for silage. This kudzu rotation seems well-suited for a livestock system of farming and for land subject to serious erosion.



Corn following an established stand of kudzu. Notice that volunteer kudzu has already covered the ground underneath the corn. *Photo courtesy of Soil Conservation Service.*

2,4-D Effective On Corn, Small Grains



2,4-D Kills Wild garlic. The cluster on the right was untreated. That on the left was sprayed with Butyl ester form of 2,4-D on November 17. The picture was taken January 9. Dormant bulblets which will germinate in the spring, make at least one spring treatment necessary.

CHEMICAL WEED CONTROL may play an important role in North Carolina agriculture, says G. C. Klingman after completing preliminary work on his weed control investigations. Klingman presents his results as a progress report rather than as completed research results.

A comparatively new material, 2,4-D (known chemically as 2,4-Dichlorophenoxyacetic acid)

proved effective in killing many of the usual weeds found in corn, small grains, grass pastures, golf courses and lawns.

Cocklebur, crabgrass and annual morning glory were the most abundant weeds in the tests on corn. Counts showed an average of three cocklebur and nine crabgrass plants per square foot with scattered annual morning glory plants. The chemicals were applied to the corn at tasseling time when the weeds were an average of three inches tall.

Sodium salt, dithanolamine, triethanolamine, butyl ester and ethyl ester forms of 2,4-D were applied as sprays. In addition, one 2,4-D dust was applied. Ammonium Dinitro Sec Butyl Phenate was used as a spray and Dinitro Artho Secondary Butyl Phenol was applied as a dust.

All forms of the 2,4-D gave effective control of the cocklebur and annual morning glory. The crabgrass plants were too large to be affected. Due to the reduced competition from weeds, corn yields were increased an average of 6.1 bushels per acre on all the 2,4-D treated plots.

One experiment was conducted on preemergence spraying of corn. All forms of 2,4-D tested appeared equally effective when compared on a free *acid* basis. Preemergence treatments appear promising, but further testing is needed before they can be recommended.

Klingman reports that, in general, the grasses, including Johnson grass and Bermuda grass, are resistant to 2,4-D. Other chemicals are being tested for control of Johnson grass, Bermuda grass, nutsedge (nutgrass) and for weed control in tobacco plant beds.

Ammonium Trichloroacetate, a new weed-killing chemical not yet on the market, killed the Bermuda grass in the above plot. Since the chemical does carry over in the soil for some time, the seeding of other crops must be delayed several months to avoid injury.



Farm Tenancy Increases In East

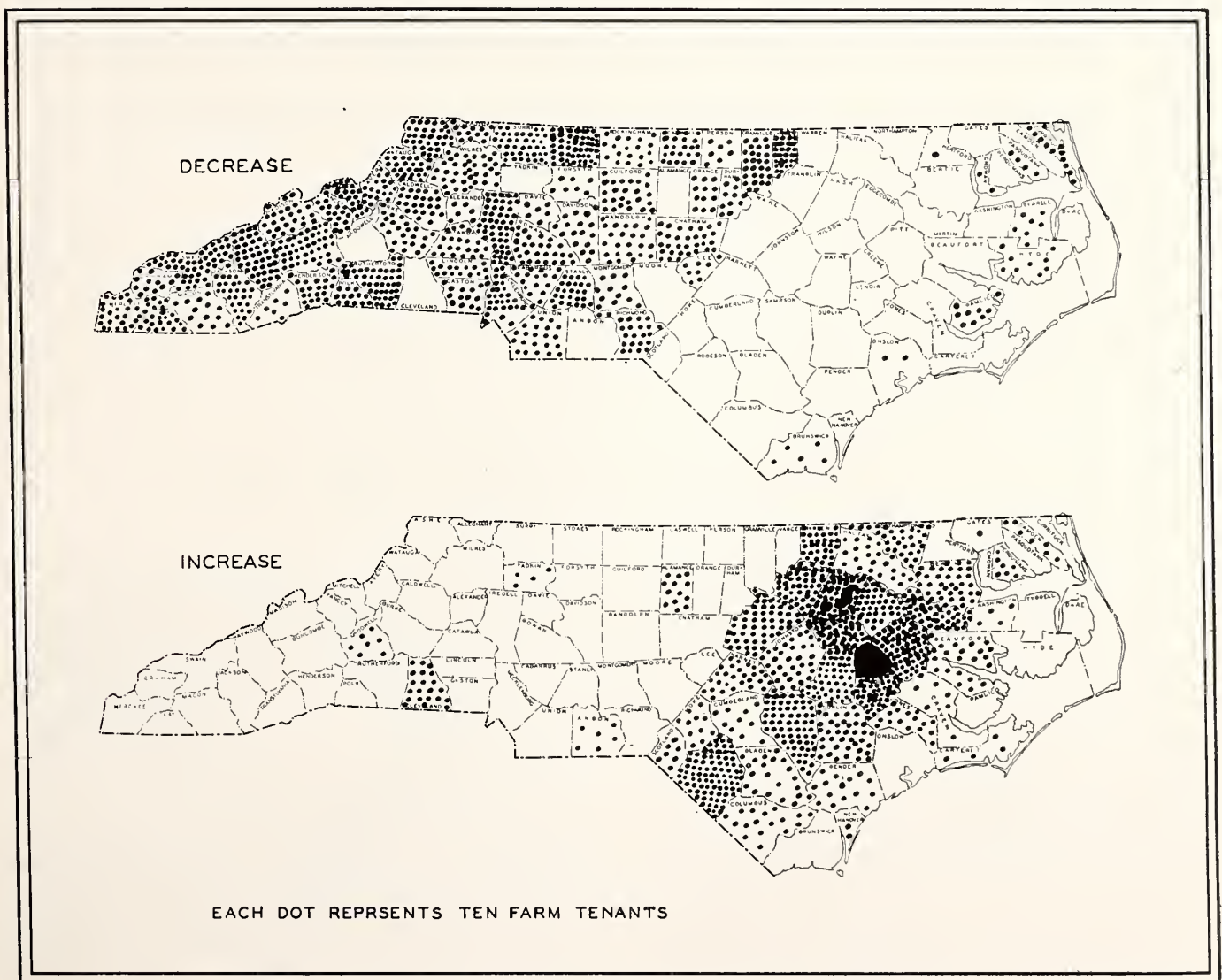
DURING WORLD WAR II, a period of rising farm prices, farm tenancy increased in eastern North Carolina as revealed in surveys by C. H. Hamilton and S. C. Mayo. Strangely enough it declined sharply in the western part of the State. The accompanying figure portrays these radically different trends.

If the State is divided into two parts, east and west, by a line drawn diagonally just west of Raleigh, it will be found that the percentage of tenancy in eastern Carolina increased from 55.3 to 57.7 per cent. This compares with a decline in the western area from 35.0 to 28.2 per cent. The increase of 11,056 tenants in the east is almost

exactly counterbalanced by a decline of 10,945 in the west.

This change in the tenancy situation is all the more interesting when viewed in historical perspective. During the great depression of the 1930's, tenancy trends were just the reverse of those during the recent war. For example, between 1930 and 1935, the percentage of eastern farms operated by tenants decreased from 59.4 to 56.5 per cent. In the west during the same period tenancy percentage remained about constant, but the total number of tenants increased by more than 7,000.

Between 1935 and 1940, tenancy continued to



Between 1940 and 1945, the number of farm tenants in western North Carolina decreased, while those in the eastern part of the state increased.

decline in the east and declined even more sharply in the west. Before World War II, farmers in eastern Carolina, having an adequate labor supply, worked their farms more and more with hired labor. When the war came, this situation was upset. Young men, white and colored, went into the armed services. Farm labor became scarce. Prices rose. Income increased, but farm wages skyrocketed even more.

This situation placed tenant farmers in a better bargaining position. To hold labor on farms, more laborer families (and others) were offered cropper and tenant arrangements. Many studies have shown that tenants and croppers earn more net income than do farm laborers in the same areas. For the same reasons, tenants (other than croppers) earn more than croppers.

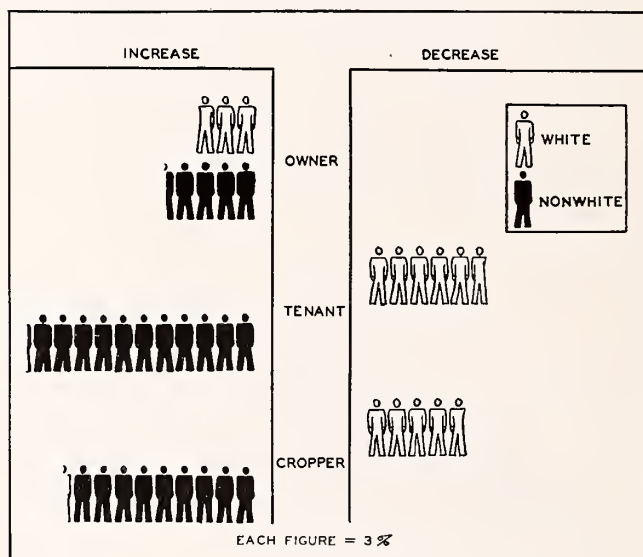
So, as might be expected, the number of Negro tenants in the heart of the tobacco belt increased during the war more than did the number of Negro sharecroppers. Even so, by 1945 the number of Negro croppers in the State had increased from a low of 26,803 in 1940 to 34,110 in 1945—almost back up to the high level of 34,805 of 1930.

In the western part of the State a different set of factors have operated to reduce tenancy. General farming, which prevails in the west, is not well adapted to commercial tenant farming. Increased farm incomes made it possible for many tenant farmers to become home owners. This could not happen so extensively in the east because of the concentration of land holdings in the hands of large scale farmers.

These trends are significant for an understanding. In the future, if the depression comes there will be an even greater decline. The only hope lies in developing types of farming which will utilize the tenants and croppers who will be displaced by the cuts in tobacco acreage.

acreage no doubt will bring a decrease in the number of Negro sharecroppers. And if another de- of the future. The prospective cut in tobacco

Both white and nonwhite farm owners increased in North Carolina between 1940 and 1945. Nonwhite tenants and croppers increased, while white croppers and tenants decreased.



People Lack Information About Farmer Cooperatives

To determine the attitudes which both farmers and non-farmers hold towards farmer cooperatives, M. A. Abrahamsen surveyed sample rural and urban groups. He found that in general farmers have a clearer view than urban people as to the aims and objects of the cooperatives. Farmers tend to look on cooperatives as their own capitalistic agencies. They believe that cooperatives bring them increasing returns for the products they sell, reduced charges for the supplies they need, improved quality and a stable agricultural economy.

The average urban dweller appears confused regarding the role of cooperatives in our economy. Charges and counter-charges by foes and friends

have contributed to the confusion. In most instances, there are indications that urban people do not have enough information upon which to judge intelligently the performance of farmers' cooperative associations.

Merchants and buyers of farm products have been critical of cooperative activities. Supply merchants are concerned about the competition from cooperatives, and question the economic role that farmer associations occupy.

In general, the survey indicated that cooperative associations and public agencies have not always conducted successful public relations programs. It pointed up a growing need for acquainting urban people with the nature of cooperatives and the part they play in the capitalistic system.

Study Reveals Weakness In Curb Market Selling

A study of Curb Markets in North Carolina by John Curtis and M. A. Abrahamsen has shown that highly seasonal and highly specialized merchandise stand in the way of turning curb market visitors into regular customers.

The study was designed to analyze the operation of the markets and recommend improvements. The organization methods and business practices were studied. Customers were surveyed to find why they patronized the markets, and what changes would induce them to become steady customers.

The merchandise was surveyed for quality and supply.

The seasonal nature of market business was shown by the fact that 40 per cent of all sales were made during the months of May, June, July and December. Forty-eight per cent of all commodity sales were for poultry and eggs, indicating the amount of specialization. Most of the markets lacked proper facilities for selling. The farm women operating the markets were found to lack training in selling techniques, and standardization of products.



Locally grown farm products are in brisk demand at the Raleigh Home Demonstration Curb Market.

Number of Farm Tractors Triple In Past Five Years

The equipping of North Carolina farms with tractors and power machinery has warranted a continuing study by R. E. L. Greene, H. Brooks James and J. G. Sutherland.

The number of farm tractors in the State has increased from 12,756 in 1940 to 31,189 in 1945. This is an increase of 144 per cent, or 18,433 tractors in five years.

Power machinery has also increased at a rapid rate. The mechanical cotton picker was operated in the State for the first time in the fall of 1945. By the fall of 1947 North Carolina farmers owned six cotton pickers and eleven strippers. Corn harvesters, combines and other tractor-drawn implements have been added to the growing list of farm machines used in the State.

Several problems of farm mechanization have been pointed up by the study.

Partial Mechanization. This is the practice of using machinery for only part of the production operations. For example, cotton may be planted and cultivated mechanically in a manner that requires little manual labor. But until harvesting equipment is perfected, the farmer still has the problem of getting his crop harvested by hand. This hand labor must either be kept on the farm or hired from the outside. The savings which result from mechanization will continue to be small until all the production operations are mechanized.

Reduction of Workstock. The number of horses and mules on North Carolina farms have not been cut down in proportion to the number of tractors added. As a result, the addition of a tractor has raised rather than lowered the power cost on many farms.

Research has shown that one medium-size tractor can replace about six mules in general crops farming. Yet farmers who bought tractors between 1940 and 1945 cut down their workstock numbers by only one-tenth. On 61 highly-mechan-

ized farms in the northern Coastal Plain in 1943 there was about twice as much power as was needed to carry on farming operations.

Limited Skilled Labor. Farm machinery must be properly adjusted and serviced to render the most efficient service. To do this, farm labor must be more highly trained.

Mechanization and Profits. Mechanization reduces the production costs of some crops more than others. As a result, some crops become more profitable, relatively. To attain the maximum profits, there should be some reorganization of the farm after mechanization.

Displaced Workstock. Land, labor and other resources necessary for the support of workstock become available when the workstock is displaced. These resources should be used for the expansion or development of productive livestock enterprises. For example, beef cattle, poultry and hogs can be added to many farms to utilize by-products and thus increase net farm income.

Size of Farm. Many farms are too small to make efficient use of modern mechanical equipment. The average farm family, if given up-to-date mechanical equipment can handle more than twice the land farmed with mules. This increase in size of farm may be a difficult adjustment in some sections of the State, but it must be made if the full benefits of mechanization are to be realized.

Cropper System of Tenure. A change in power and labor needs may require a change in the division of expenses and receipts between landlords and tenants. It may also mean a shift of more of the managerial responsibilities to the tenants.

Farm Labor Surplus. As modern mechanized methods are extended to farming, the productivity per farm laborer will increase, meaning that less labor will be needed. Surplus laborers will be confronted with the problem of finding jobs outside of agriculture. This important social problem emphasizes the need for maintaining a high level of industrial employment.



Dr. J. H. Hilton, (right) Director, and Dr. R. W. Cummings, Associate Director, assumed their new duties on January 1, 1948.

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FINANCIAL REPORT

of the

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

For the Year Ended June 30, 1947

CERTIFICATION

We, the undersigned, certify that the receipts and expenditures shown in this report from Federal funds and as offset to Bankhead-Jones funds are correct; that the expenditures were solely for the purposes set forth in the acts of Congress approved March 2, 1887 (Hatch), March 16, 1906 (Adams), February 24, 1925 (Purnell), May 16, 1928 (Hawaii), February 23, 1929 (Alaska), March 4, 1931 (Puerto Rico), June 29, 1935 (Bankhead-Jones, Title I), June 20, 1936 (Alaska), and March 4, 1940 (Employer Contributions to Retirement); that the expenditures are in accordance with the terms of said acts so far as applicable to this station; and that properly approved vouchers are on file for all expenditures.

We further certify that the sum of \$ (None) was the total amount earned as interest on the deposit of Hatch, Adams, Purnell, and Bankhead-Jones funds and that this amount has been remitted to the Treasurer of the United States through the United States Department of Agriculture.

(Signed) L. D. BAVER,
Director of Experiment Station

(Signed) J. G. VANN,
(Legal Custodian of Federal Funds)
Assistant Controller
North Carolina State College of
Agriculture and Engineering

(Seal of Institution)

Receipts And Expenditures

Under Hatch, Adams, Purnell, and Bankhead-Jones Acts, and the State Offset Required by the Bankhead-Jones Act

Fiscal Year ended June 30, 1947

RECEIPTS

	Balance From 1946-47	Receipts From U. S. Treasury	Total
FEDERAL FUNDS:			
Hatch	\$ None	\$ 15,000.00	\$ 15,000.00
Adams	None	15,000.00	15,000.00
Purnell	None	60,000.00	60,000.00
Bankhead-Jones	None	114,926.05	114,926.05
For Bankhead-Jones Offset	440,249.05

EXPENDITURES

Purpose	Fund			
	Hatch	Adams	Purnell	Bankhead-Jones
Personal Services:				
Administration	\$12,971.85			
For all other purposes		\$13,464.72	\$49,566.13	\$92,829.10
Travel	258.15	140.71	3,801.37	4,236.22
Transportation of Things	57.81	29.57	7.56	304.70
Communication Service	38.87	.62	305.53	440.16
Rents and Utility Services:				
Heat, light, power, water, gas, electricity			14.74	149.16
Rent of space in buildings or equipment				1.62
Rent of land				50.00
Printing and Binding:				
Printing publications	646.25		194.96	60.37
Other printing, and binding			73.65	142.36
Other Contractual Services:				
Repairs and alterations to equipment, and other contractual services not otherwise classified	205.11	94.83	774.60	2,297.74
Supplies and Materials:				
Other supplies and materials	813.96	577.41	3,519.58	9,366.83
Equipment	8.00	692.14	1,741.88	5,047.79
TOTAL EXPENDITURES	15,000.00	15,000.00	60,000.00	114,926.05

Non-Federal Funds

Fiscal Year Ended June 30, 1947

Funds Available

	For All Purposes	For Agricultural Investigations
State appropriations or allotments:	\$351,739.38	\$336,210.65
Sales	68,232.39	68,232.39
Miscellaneous (Commercial Gifts)	35,806.03	35,806.03
	<hr/>	<hr/>
Total	455,777.80	440,249.07

Classification of Expenditures

for

Agricultural Investigations

Personal Services	\$249,112.73
Travel	13,320.27
Transportation of Things	1,036.31
Communication Service	3,709.74
Rents and Utility Services	5,717.59
Printing and Binding	3,537.66
Other Contractual Services	16,135.91
Supplies and Materials	57,817.41
Equipment	27,958.53
Lands and Structures (Contractual)	16,843.05
Bonuses and Emergency Salaries	45,059.87
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TOTAL EXPENDITURES	\$440,249.07
Unexpended Balance	<hr/>
TOTAL FUNDS AVAILABLE	440,249.07

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